

AD-A152 694

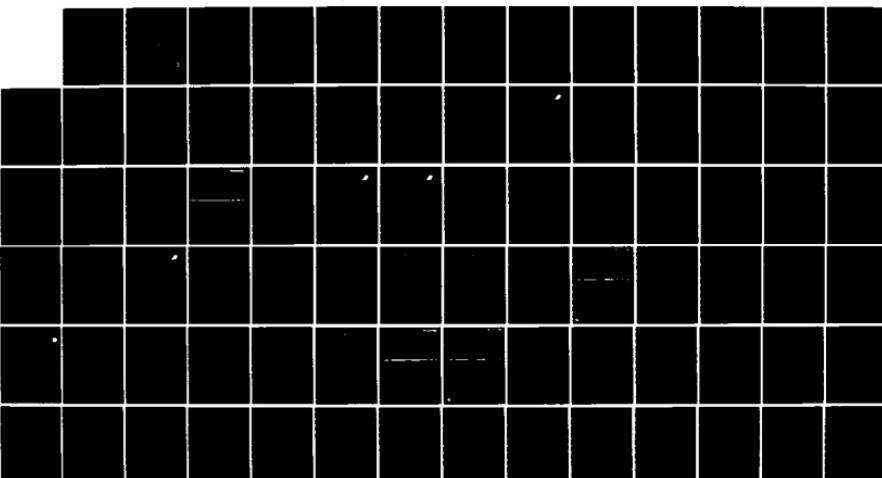
FABRICATION OF DIGICONS FOR THE SHAD EXPERIMENT(U)  
SCIENCE APPLICATIONS INTERNATIONAL CORP SAN DIEGO CA  
31 DEC 84 SRIC-84/1842 N00014-82-C-0363

1/1

UNCLASSIFIED

F/G 9/1

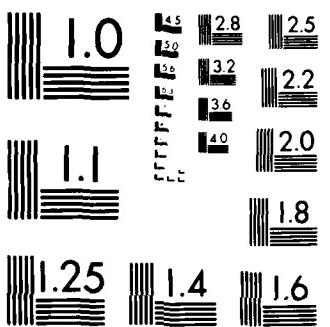
NL



END

FORM 60

2400



MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS 1963 A

(12)

AD-A152 694

FABRICATION OF DIGICONS  
FOR THE  
SHAD EXPERIMENT

FINAL REPORT

Contract N00014-82-C-0363

SCIENCE APPLICATIONS, INC.

DTIC FILE COPY

DISTRIBUTION STATEMENT A  
Approved for public release  
Distribution Unlimited

DTIC  
ELECTED  
APR 24 1985  
S D

85 0 00 00

FABRICATION OF DIGICONS  
FOR THE  
SHAD EXPERIMENT

FINAL REPORT

Contract N00014-82-C-0363

December 31, 1984

Prepared by:

Science Applications International Corporation  
Electronic Vision Systems Division  
11526 Sorrento Valley Road  
San Diego, California 92121

Prepared for:

Office of Naval Research  
Department of the Navy  
800 North Quincy Street  
Arlington, Virginia 22217

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unclassified	<input type="checkbox"/>
Justification	
By _____	
Distribution/ _____	
Availability Codes	
Avail and/or	Special
Dist	Special

A-1  
ltronjic

<u>DISTRIBUTION STATEMENT A</u>	
Approved for public release	
Distribution Unlimited	



SCIENCE APPLICATIONS, LA JOLLA, CALIFORNIA  
ALBUQUERQUE • ANN ARBOR • ARLINGTON • ATLANTA • BOSTON • CHICAGO • HUNTSVILLE  
LOS ANGELES • MCLEAN • MO ALTO • SANTA BARBARA • SUNNYVALE • TUCSON

10401 Roselle Street, San Diego, California 92121

## TABLE OF CONTENTS

<u>SECTION</u>		<u>PAGE</u>
1.0	PURPOSE.....	1
2.0	SHAD DIGICON DESIGN.....	2
2.1	Background.....	2
2.2	SHAD Design.....	2
3.0	HARDWARE FABRICATION AND TESTING.....	11
3.1	Breadboard Tubes.....	11
3.1.1	Breadboard Tube Fabrication.....	11
3.1.2	Breadboard Tube Encapsulation and Testing..	11
3.2	Space-Qualified Tubes.....	12
3.2.1	Space-Qualified Parts Procurement.....	12
3.2.2	Space-Qualified Tube Fabrication.....	12
3.2.3	Space-Qualified Tube Testing.....	13
3.2.4	Space-Qualified Tube Delivery.....	14
	APPENDIX A—SHAD SPACE-QUALIFIED TUBES TEST DATA.....	15

## LIST OF FIGURES

<u>FIGURE</u>		<u>PAGE</u>
1	Quadrant Digicon—Unencapsulated View.....	3
2	SAIC Drawing No. 131-18-111 203.....	6
3	SAIC Drawing No. 131-18-110 000.....	8
4	SAIC Drawing No. 131-18-110 001.....	9

## LIST OF TABLES

<u>TABLE</u>		<u>PAGE</u>
1	SHAD Quadrant Digicon Performance Goals.....	4

## 1.0 PURPOSE

The purpose of this program is to provide the necessary personnel and facilities required to design, fabricate, test, and deliver the intensified quadrat photomultiplier tubes (Digicons) required to support the SHAD experiment. Deliverables included two (2) breadboard tubes, three (3) space-qualified tubes, reports, and data.

All work required by this contract has been accomplished. Two (2) breadboard tubes were fabricated, the design verified through testing and the tubes delivered. Three (3) space-qualified tubes have been fabricated, tested, and delivered. All reports and data requirements will have been satisfied with the submittal of this final report.

## 2.0 SHAD DIGICON DESIGN

### 2.1 BACKGROUND

The design of the quadrant photo tube for the SHAD Experiment was derived from the quadrant Digicon guider tube developed by SAIC under contract to the University of Maryland.

The Digicon tube is an imaging tube with a photocathode as an electron source on one end and a monolithic silicon photodiode array as a detector on the other end (Fig. 1). Electrons produced by incoming photons at the photocathode are accelerated by an electrostatic field and detected by the diode array. Each photodiode serves as the high-gain first stage of a detector channel, producing a charge pulse of approximately 5000 electron-hole pairs for each incident photoelectron. Each current pulse is amplified by a charge sensitive preamplifier and is "counted" if it exceeds a preset discriminator threshold level. The Digicon is characterized by a wide dynamic range, low noise, high photometric accuracy, and high reliability.

### 2.2 SHAD DESIGN

The design goals for the SHAD Flight-Qualified tube are listed in Table 1. In order to satisfy them, revisions were made to the internal tube structure making it more compatible with the vibration environment to be encountered. The quadrant diode array design was revised to specify the tighter inter-diode spacing recommended by Dr. Currie. See Fig. 2 SAIC Drawing No. 131-18-111-203.

The packaging and encapsulation design was completely revised for this application. The magnetic shield was redesigned to provide a closed shield. The encapsulant and HV cables were changed in order to be compatible with the requirement for use of space-qualified materials, and the method of attaching the High Voltage cable revised to accommodate the spacecraft's environmental requirements.

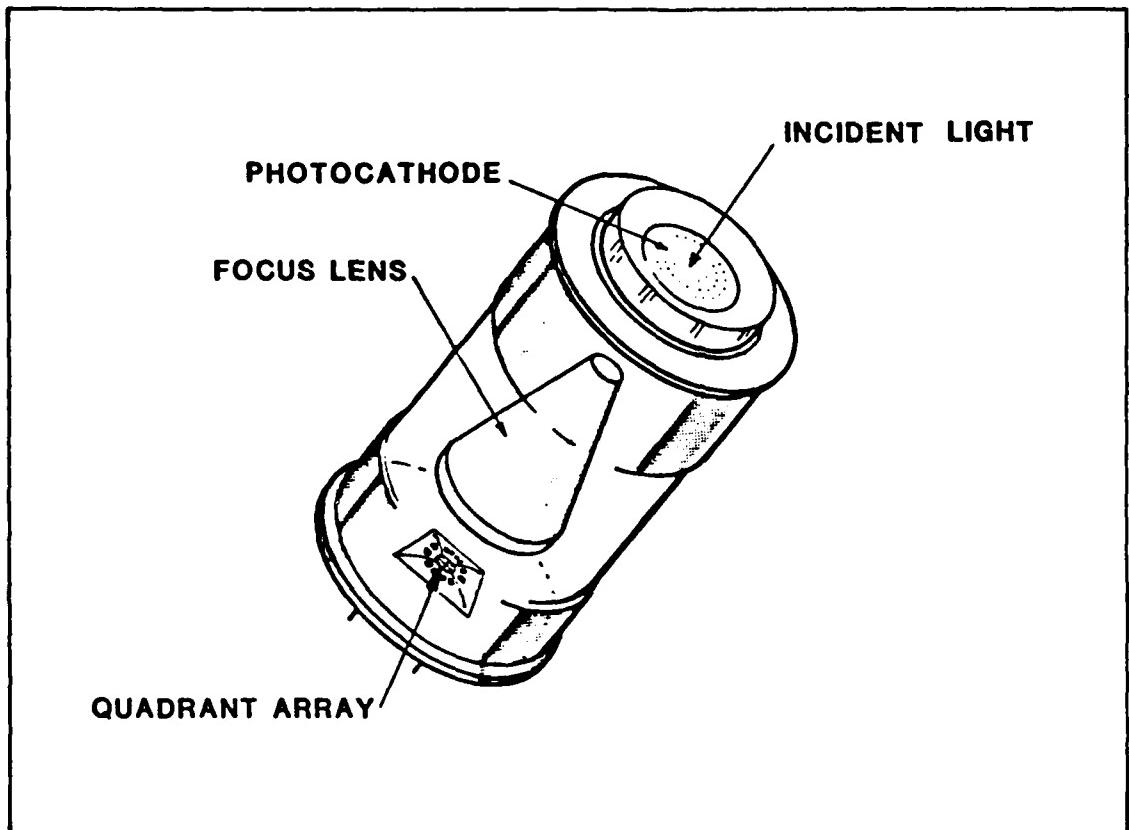


Figure 1. Quadrant Digicon—Unencapsulated View.

Table 1. SHAD Quadrant Digicon Performance Goals.

1. PHYSICAL (See Figure 4)

- Length                    3.50"  $\pm$  0.01"
- Diameter                2.00"  $\pm$  0.01"
- Weight                   $\leq$  350 grams
- Array Configuration    See Fig. 2

2. ELECTRICAL

- Diode Leakage Current (6V Reverse Bias)     $\leq$  1 nA (4 central diodes)
- Diode Capacitance (6V Reverse Bias)         $\leq$  15 pf (4 central diodes)
- $\Delta E/E$  at 15 kV                             $\leq$  0.25 (4 central diodes)

3. PERFORMANCE AT 15 kV

- Photocathode Quantum Efficiency              400 nm    25%  
    500 nm    15%  
    700 nm    2.5%  
    800 nm    0.1%
- Dark Count                                     $\leq$  25 ct/sec/diode (avg of 4 central diodes)
- Magnification                                 $0.6 < m < 1$
- Error Function (10-90%)                     $50\mu$
- Uniformity (4 central diodes)             $\pm 5\%$

4. ENVIRONMENTAL

- Vacuum Operation                            Compatible
- Temperature                                 $-40^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$
- Vibration                                 See SHAD Vibration Levels

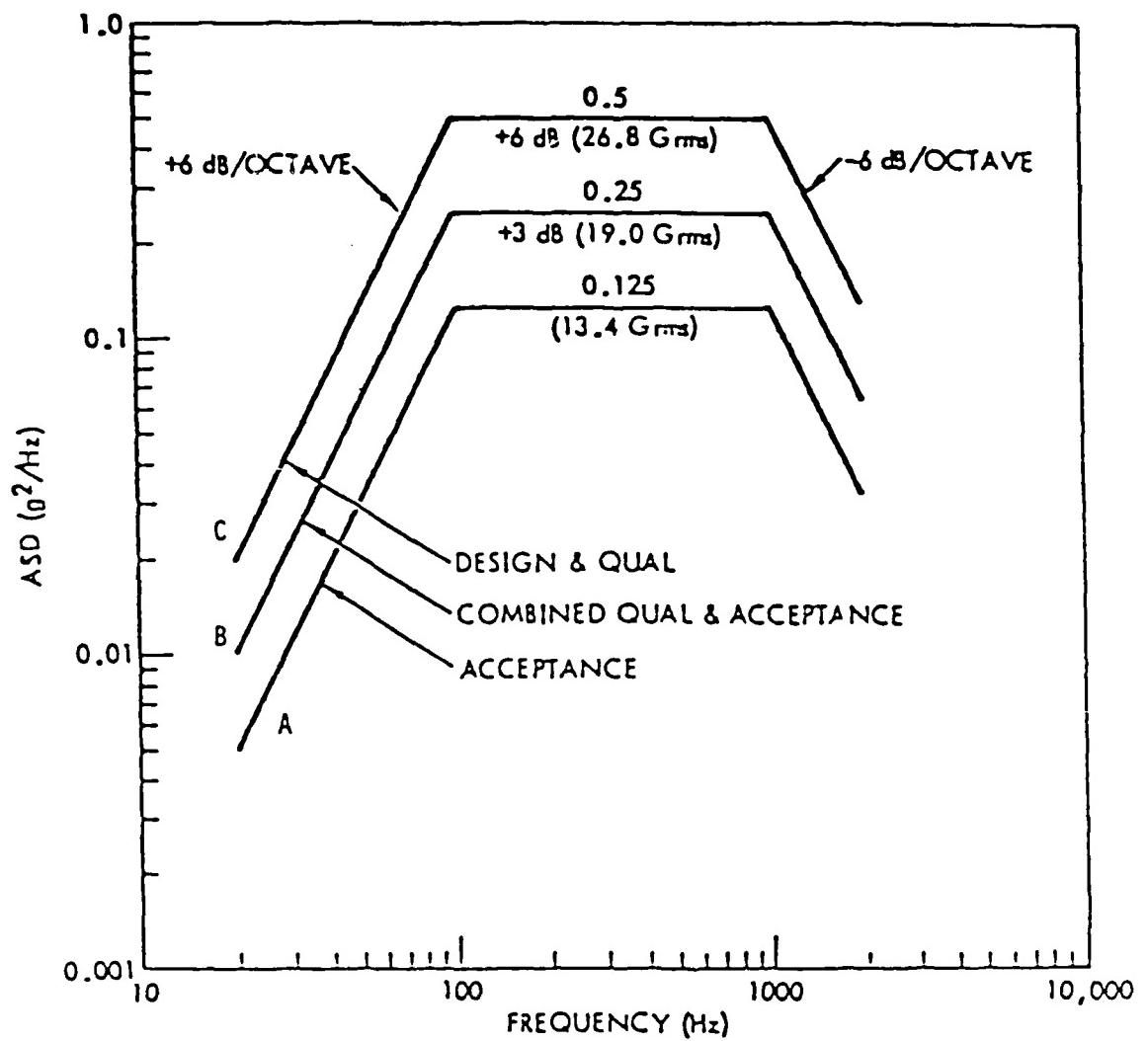


Figure 5. SHAD Vibration Levels

#### INTERFACE CONTROL DOCUMENT

DOCUMENT SPECIFIES TECHNICAL REQUIREMENTS AND  
THING HEREIN CONTAINED SHALL BE DEEMED TO ALTER  
TERMS OF ANY CONTRACT OR PURCHASE ORDER BE-  
EN ALL PARTIES Affected

SIZE	CODE IDENT NO.	DRAWING NO.
A	03953	MH09-00006-400
SCALE	REV	SHEET 10 OF

41104-38 REV B-70

Table 1 (Continued)

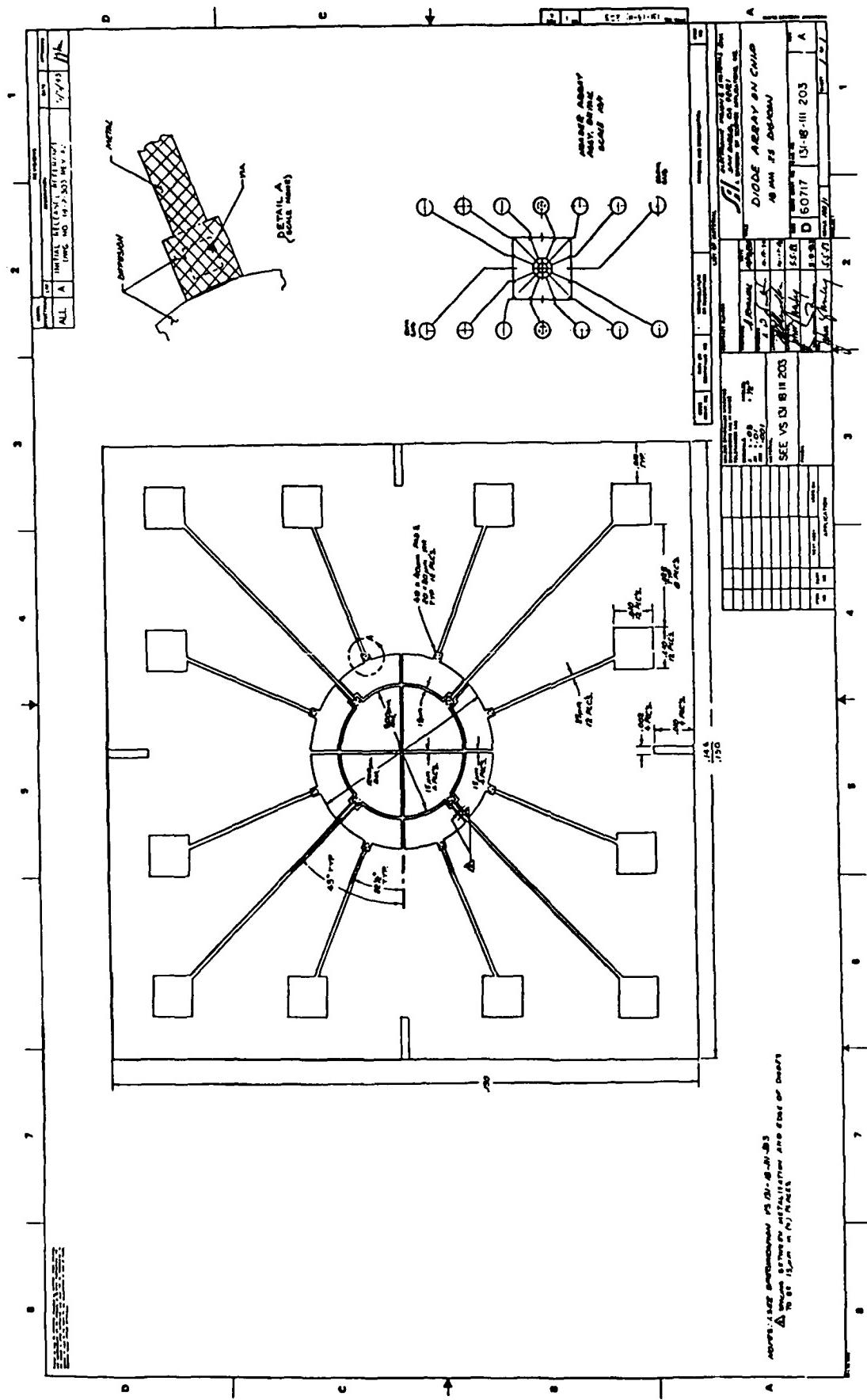


Figure 2. SAIC Drawing No. 131-18-111 203

The encapsulation technique has been described in detail in a report to ONR, SAI-83/1421, dated December 1, 1983. The final encapsulated tube assembly is shown in Fig. 3, SAIC Drawing No. 131-18-110-000. The interface drawing, SAIC Drawing No. 131-18-110-001 is provided in Fig. 4.

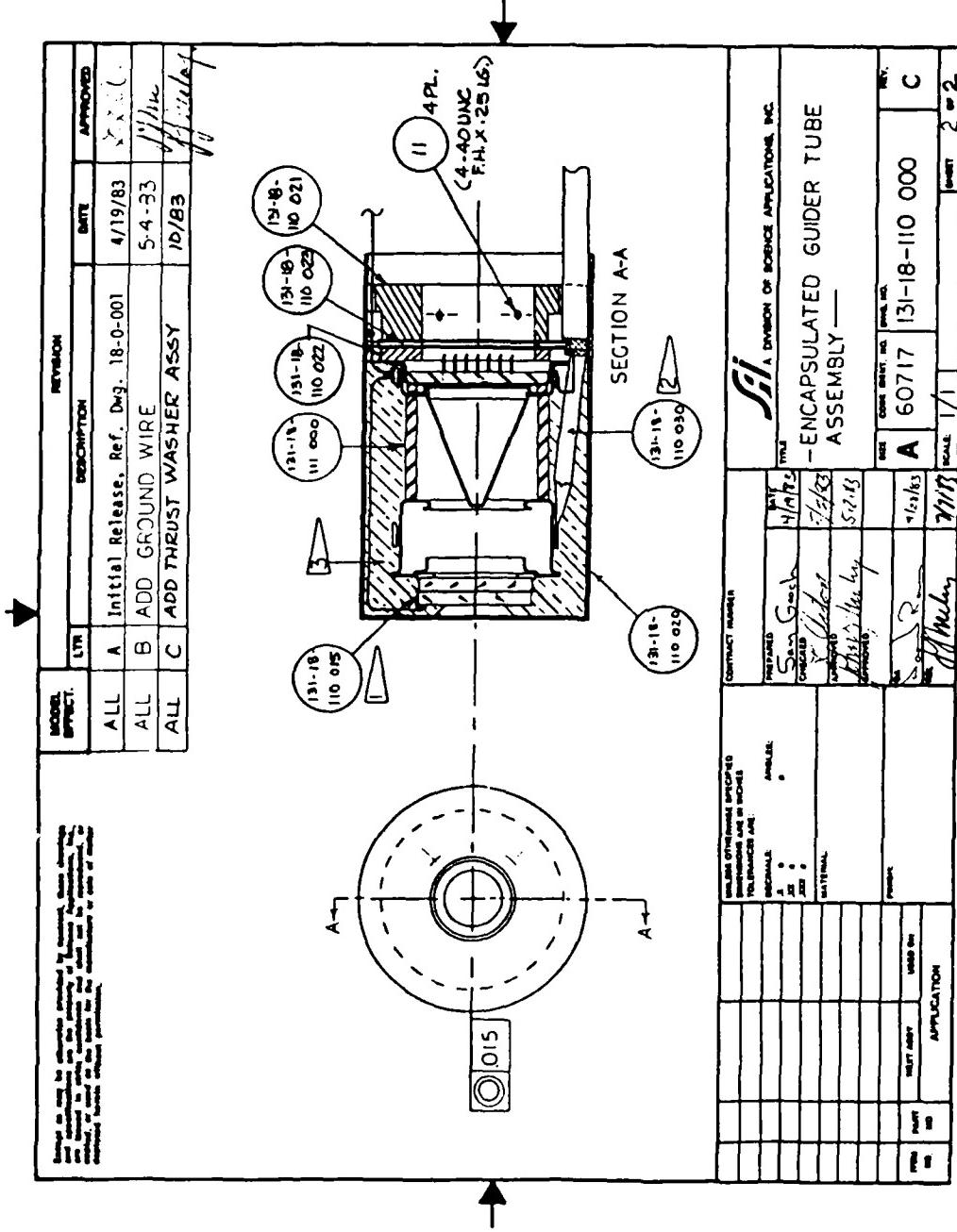


Figure 3. SAIC Drawing No. 131-18-110 000.

DUU

.3.a

TUBE NO. 673-3 12KVDATE 5/17/84DIGICON PERFORMANCEa. MAGNIFICATION

DIODE (2)

	1/2	CENTER	1/2
$\mu$ Divisions	<u>5510</u>	<u>5070</u>	<u>4850</u>
Count Rate	<u>1926</u>	<u>3965</u>	<u>1925</u>
S (Total No. Divisions)			<u>540</u>
$W = S * (\mu/\text{Divisions}) =$	*		=
$M (\text{Magnification}) = D/W =$	<u>400</u>	<u>1660</u>	<u>.606</u>
(D = Diode Width)			

DIODE (1)

	1/2	CENTER	1/2
$\mu$ Divisions	<u>4890</u>	<u>4450</u>	<u>4240</u>
Count Rate	<u>1925</u>	<u>4290</u>	<u>2072</u>
S (Total No. Divisions)			<u>650</u>
$W = S * (\mu/\text{Divisions}) =$	*		=
$M (\text{Magnification}) = D/W =$	<u>400</u>	<u>1650</u>	<u>.615</u>
(D = Diode Width)			

$$(\text{Average Magnification}) \left( \frac{M_1 + M_2}{2} \right) = .610 \quad \text{Goal} = 0.6 < M < 1$$

TEST ENGINEER

L. Olson 5-17-84 QA(SAIT  
QE4) 5/17/84CUSTOMER (if applicable) N/AFOCUS POSITION 1.0250 cm

18-4.2  
ge 7

TUBE NO. 673-5  
DATE 5/29/84

QUAD DIGICON ARRAY RESPONSE

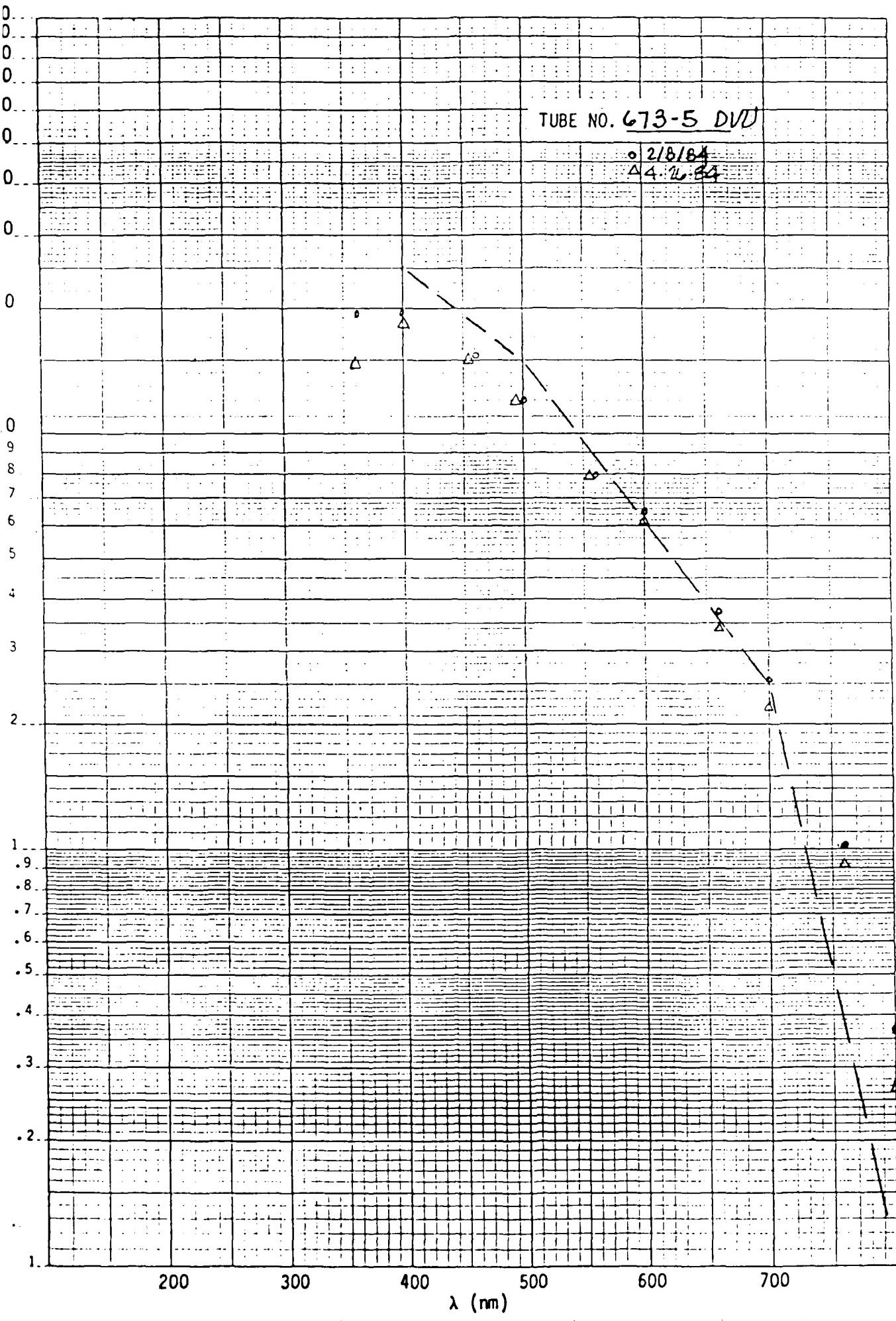
DIODE	PIN	LEAKAGE CURRENT (nA) Goal ≤ 1 nA	CAPACITANCE (pf) Goal ≤ 15 pf	ΔE/E Goal ≤ 0.25
Q1	2	0.11	10.8	0.29
Q2	5	0.16	10.7	0.29
Q3	9	0.08	10.4	0.30
Q4	12	0.08	10.0	0.28
G1	1	0.04	8.6	0.29
G2	3	0.09	7.7	0.30
G3	4	0.15	6.9	0.30
G4	6	0.14	6.8	0.27
G5	8	0.06	8.4	0.28
G6	10	0.05	8.0	0.28
G7	11	0.04	8.8	0.27
G8	13	0.03	7.1	0.27

5/29/84  
SAIT DE4

TUBE NO. 673-5 DVD

○ 2/8/84

△ 4.2.84



TUBE NO. 673-5 DVUDATE 4.26.84ENCAPSULATED  
IN SHIELD

## PHOTOCATHODE RESPONSE

Visible Current Mode Quantum Efficiency Data Sheet

Wave-Length (nm)	Tube Signal (A)	Calibration Standard Signal (A)	Standard Calibration (QE%)	Comments	Calculated QE (%)	Goal QE (%)
360	.360 ± .9	.47 ± .9	19.3	BLUE FILTER	14.8	
400	.625 ± .8	.521 ± .8	15.4		18.5	25.0
460	1.68 ± .8	1.17 ± .8	10.5		15.1	
500	.765 ± .8	.496 ± .8	7.96	NO FILTER	12.3	15.0
560	.349 ± .8	.539 ± .9	5.09		5.02	
600	.755 ± .8	468 ± .8	3.86	YELLOW FILTER	6.23	
660	.570 ± .8	.375 ± .8	2.52		3.83	
700	.380 ± .8	.268 ± .8	1.72		2.44	2.5
760	.522 ± .8	.411 ± .8	.726		.922	
800	.126 ± .8	.111 ± .8	.245	V	.278	0.1

Test Engineer E. Jozin QA \_\_\_\_\_SAIT  
OEA

4/26/84

Customer (if applicable) N/ACalculated QE% =  $\frac{\text{Tube Signal}}{\text{Calibration Standard Signal}} \times \text{Standard Calibration QE\%}$

ENCAPSULATED DIGICON ACCEPTANCE TESTS (SHAD)

DIGICON NO. 673-5 DVU

	<u>TEST</u>	<u>DATE</u>
4.1	PHOTOCATHODE RESPONSE (QE)	<u>4/26/84</u>
4.2	DIODE ARRAY RESPONSE	
	a. Leakage	<u>5/29/84</u>
	b. Capacitance	<u>5/29/84</u>
	c. ΔE/E	<u>5/29/84</u>
4.3	DIGICON PERFORMANCE	
	a. Magnification	<u>5/17/84</u>
	b. Error Function	<u>5/17/84</u>
	c. Dark Count	<u>5/17/84</u>
	d. Uniformity	<u>5/17/84</u>
4.4	PHYSICAL	
	a. Diameter	<u>5/25/84</u>
	b. Length	<u>5/25/84</u>
	c. Centering	<u>5/25/84</u>
	d. Weight	<u>5/25/84</u>

Data Distribution:

- Test Build Log Book
- Test Lab
- Tube Engineer
- Quality Assurance
- Customer
- File

May 30, 1984

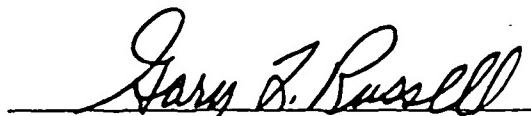
SHAD QUAD DIGICON [1-131-08-645]

SAI P/N: 131-18-110-000  
S/N: 673-5 (DVU)

Contract No: N00014-82-C-0363  
Office of Naval Research

CERTIFICATE OF PERFORMANCE

This is to certify that the item noted was tested in accordance with the SAI Acceptance Test Procedure AT-18-4.1— Photocathode Response (QE), AT-18-4.2A— Diode Array Response, AT-18-4.3A— Digicon Performance, and AT-18-4.4— Physical, Mechanical Dimensions. Test Data Summary Sheets are attached for each test. Physical test reports and data on file at this facility and are available for review by ONR.

  
\_\_\_\_\_  
Gary L. Russell  
Quality Assurance

Distribution: SAI Test  
SAI QA  
SAI Contracts (4)  
SAI File

**Science Applications, Inc.** 11526 Sorrento Valley Road, Suite A, San Diego, California 92121, (619) 458-3700

Other SAI Offices: Albuquerque, Ann Arbor, Arlington, Atlanta, Boston, Chicago, Huntsville, La Jolla, Los Angeles, McLean, Palo Alto, Santa Barbara, Sunnyvale & Tucson

SERIAL NUMBER 673-5  
DESIGN VERIFICATION UNIT (DVU)

APPENDIX A  
SHAD SPACE-QUALIFIED TUBES TEST DATA

673-5	Design Verification Unit (DVU)
676-5	First Flight Tube (F-1)
691-5	Second Flight Tube (F-2)
674-5	Third Flight Tube (F-3)
672-5	Unencapsulated Tube (Spare)

All tests were monitored by both SAIC Quality Engineering and the appointed Government representative.

Test data is included in Appendix A.

### 3.2.4 Space-Qualified Tube Delivery

The Design Verification Unit (DVU) was delivered to ONR at ITE, Beltsville, Maryland on June 1, 1984.

Following selection by ONR, Tube S/N 676-5 was selected to be encapsulated into the first Space-Qualified Tube (F-1). This tube was delivered on June 6, 1984.

Following the processing and testing of the redder photocathode tubes, Tube S/N 691-5 and S/N 674-5 were selected for use in the second and third Space-Qualified Tubes (F-2 and F-3). These tubes were delivered on October 8, 1984 and December 3, 1984, respectively.

Tube S/N 672-5, which is a good operating device but not selected for use as a deliverable flight tube, is still unencapsulated. It is being held in SHAD residual inventory at SAIC.

<u>Tube Run No.</u>	<u>Tube S/N</u>	<u>Results</u>	<u>Assignment/Use</u>
4	672-5	Good Tube	Hold in Residual
5	673-5	Good Tube	DVU Tube
6	674-5	Good Tube	F-3 Tube
7	676-5	Good Tube	F-1 Tube

At this point SAIC was directed to attempt a "redder" photocathode. Three cathode tests were performed on S/N 686, 688 and 690. Then the last two tube runs were made using the "redder" photocathode process.

8	691-5	Good Tube	F-2 Tube
9	695-5	Noisy Tube	Scrap

### 3.2.3 Space-Qualified Tube Testing

Testing of the Space-Qualified Tubes was performed in accordance with the SHAD Test Plan, TP 131-08-645-01, Rev. A, and the SHAD Acceptance Test Procedures, AT 18-4.0, AT 18.1, AT 18.2, AT 18.3, and AT 18.4. Testing included the following:

- Manufacturing Tests
  - Incoming Inspection
  - In-Process Inspection
- Unencapsulated Digicon Tests
  - Photocathode Response
  - Diode Response
  - Digicon Performance
  - Physical Inspection
- Encapsulated Digicon Tests
  - Photocathode Response
  - Diode Response
  - Digicon Performance
  - Physical Inspection

Unencapsulated tests were performed on all tubes produced. Encapsulated Tube Acceptance Tests were performed on the Design Verification Unit (DVU) and on the three flight tubes delivered (F-1, F-2, and F-3).

The encapsulated tube design was revised, modifying the anti-corona shield and the potting/installation techniques.

The first SHAD breadboard tube was re-encapsulated in the revised configuration which successfully passed thermal cycling between +55°C and -45°C. This tube was delivered to ONR at ITE, Beltsville, Maryland on October 5, 1983 for integration testing.

The second breadboard tube (S/N 651-5) was encapsulated in the new configuration. It received functional performance testing, thermal cycling, and vibration testing, passing all successfully. This tube was delivered to ONR at ITE on October 6, 1983.

### 3.2 SPACE-QUALIFIED TUBES

#### 3.2.1 Space-Qualified Parts Procurement

The parts for fabrication of the Space-Qualified Tubes were procured under a separate contract, N00014-82-C-0708. All parts were received, inspected, and tested. We found, upon testing, that the diode arrays fabricated for these tubes failed during vacuum bake. After several reworks and weeks of delays, the problems being experienced (with metalization) were identified, and we received usable diode arrays.

#### 3.2.2 Space-Qualified Tube Fabrication

Nine tube runs were completed for the fabrication of Space-Qualified tubes. The sequence and results are listed below:

<u>Tube Run No.</u>	<u>Tube S/N</u>	<u>Results</u>	<u>Assignment/Use</u>
1	661-5	Indium Seal Failure	Scrap
2	670-5	Diodes High Leakage	Scrap
3	671-5	Diodes High Leakage/Seal	Scrap

At this point the diode problem was identified and corrected.

## 3.0 HARDWARE FABRICATION AND TESTING

### 3.1 BREADBOARD TUBES

The first phase of this program was to design, fabricate, encapsulate, and test two (2) breadboard tubes of the design to be used in the space-qualified devices to follow.

#### 3.1.1 Breadboard Tube Fabrication

The two breadboard quadrant tubes were fabricated successfully and tested for operation. These were, respectively, S/N 638-5 and 651-5.

Tube S/N 638-5 was selected for encapsulation processing and test while S/N 651-5 was designated the life and environmental test unit. The Life Test was performed on this tube with no unacceptable degradation of performance after the scheduled accumulation of  $10^{12}$  electrons.

#### 3.1.2 Breadboard Tube Encapsulation and Testing

The encapsulation process for the SHAD flight Digicons was developed using space-compatible materials based on experience with the University of Maryland quad guider tubes and with the ST FOS flight Digicons. This process was tested on a non-operating tube and the problems initially encountered with material compatibility, adhesion, and surface preparation worked out. Following successful processing of non-working tubes, the first SHAD breadboard tube, S/N 638-5, was encapsulated using this process. Post-encapsulation testing revealed that the tube was no longer operational. We dissected the tube and found that the indium seal had failed, most probably during the encapsulant's cure cycle. It appears that the force on the tube's anti-corona shield due to differential expansion during the potting cure was sufficient to mechanically force the faceplate from its indium seal. Additional problems were found during thermal testing of the encapsulated assembly.

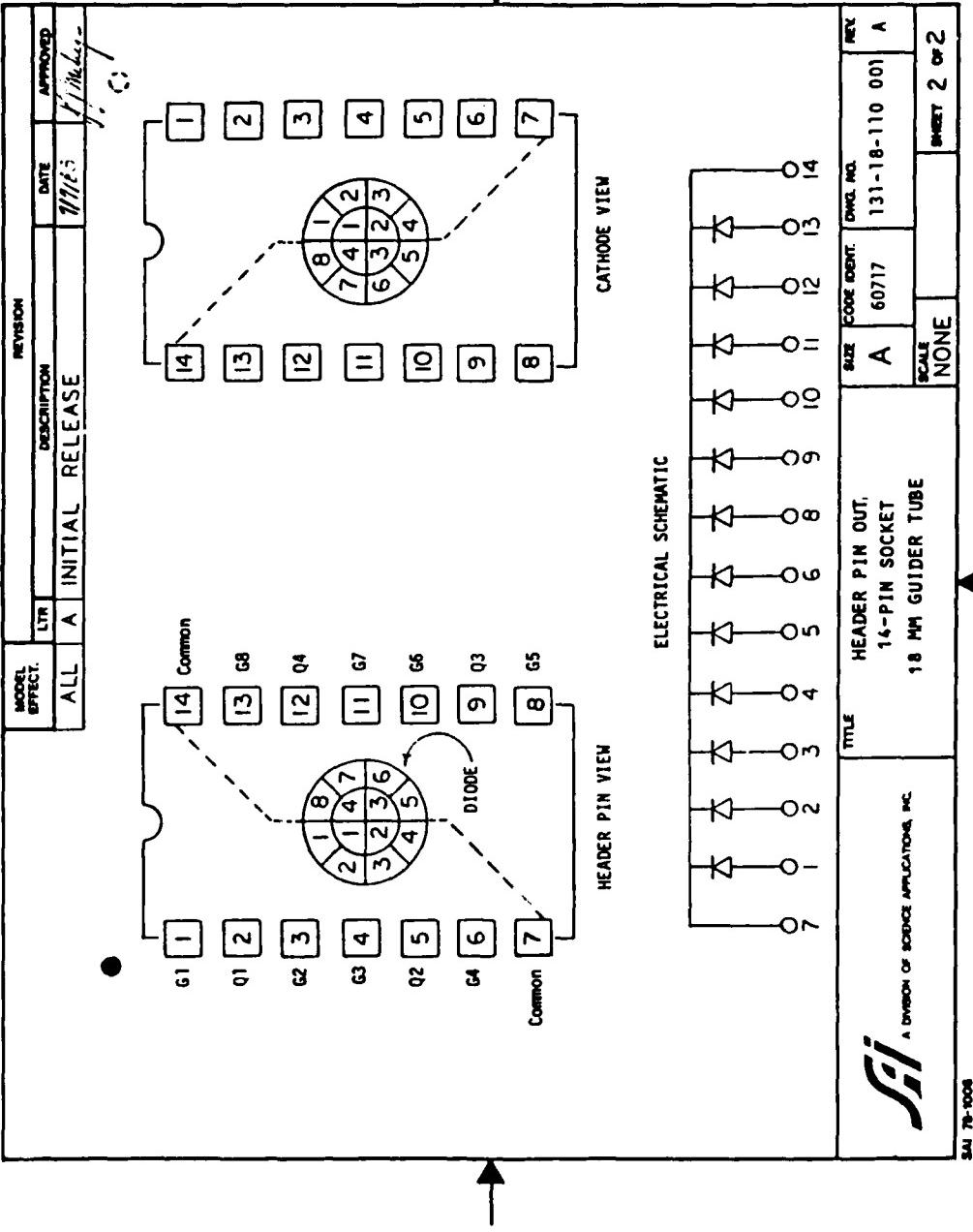


Figure 4 (Continued).

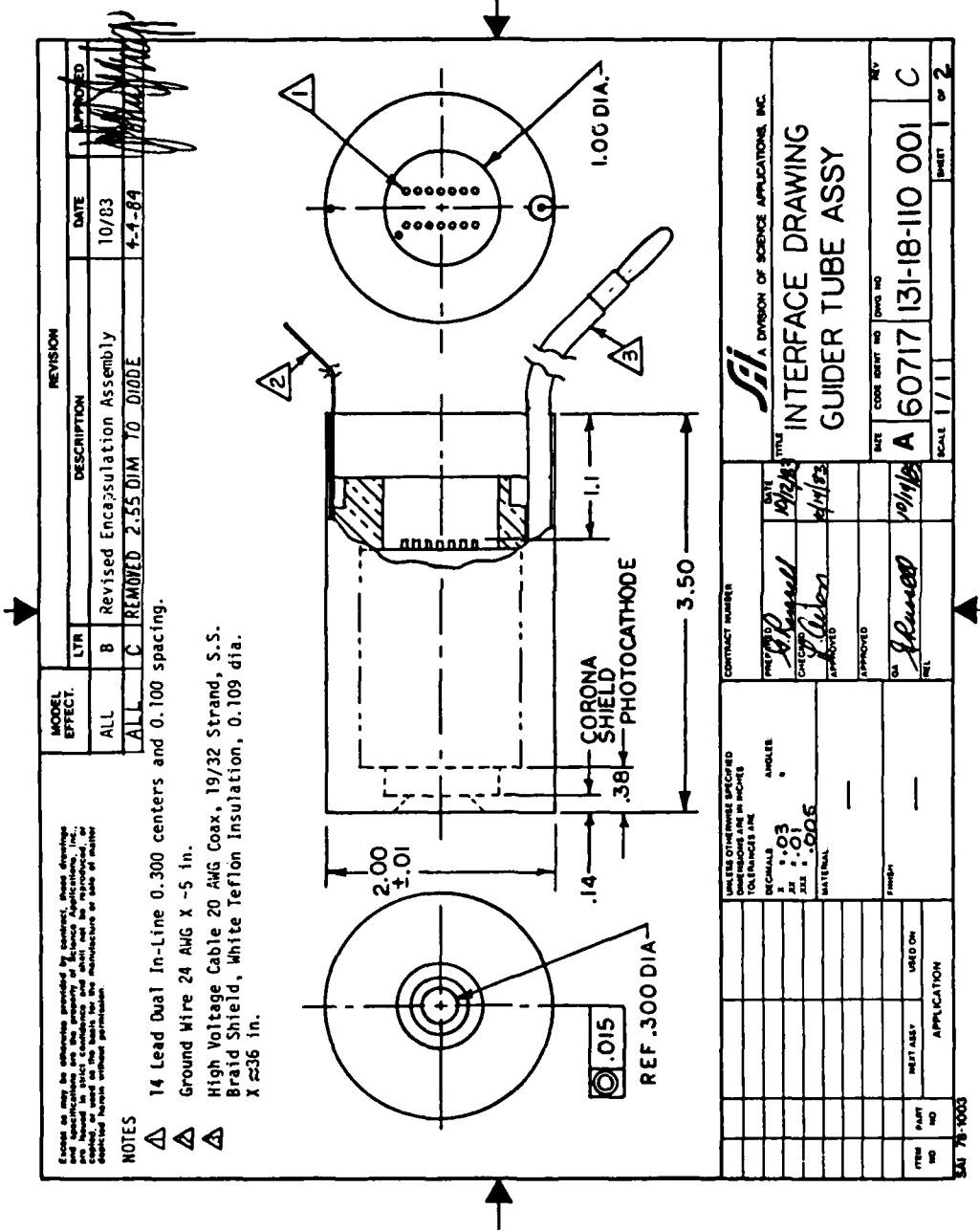
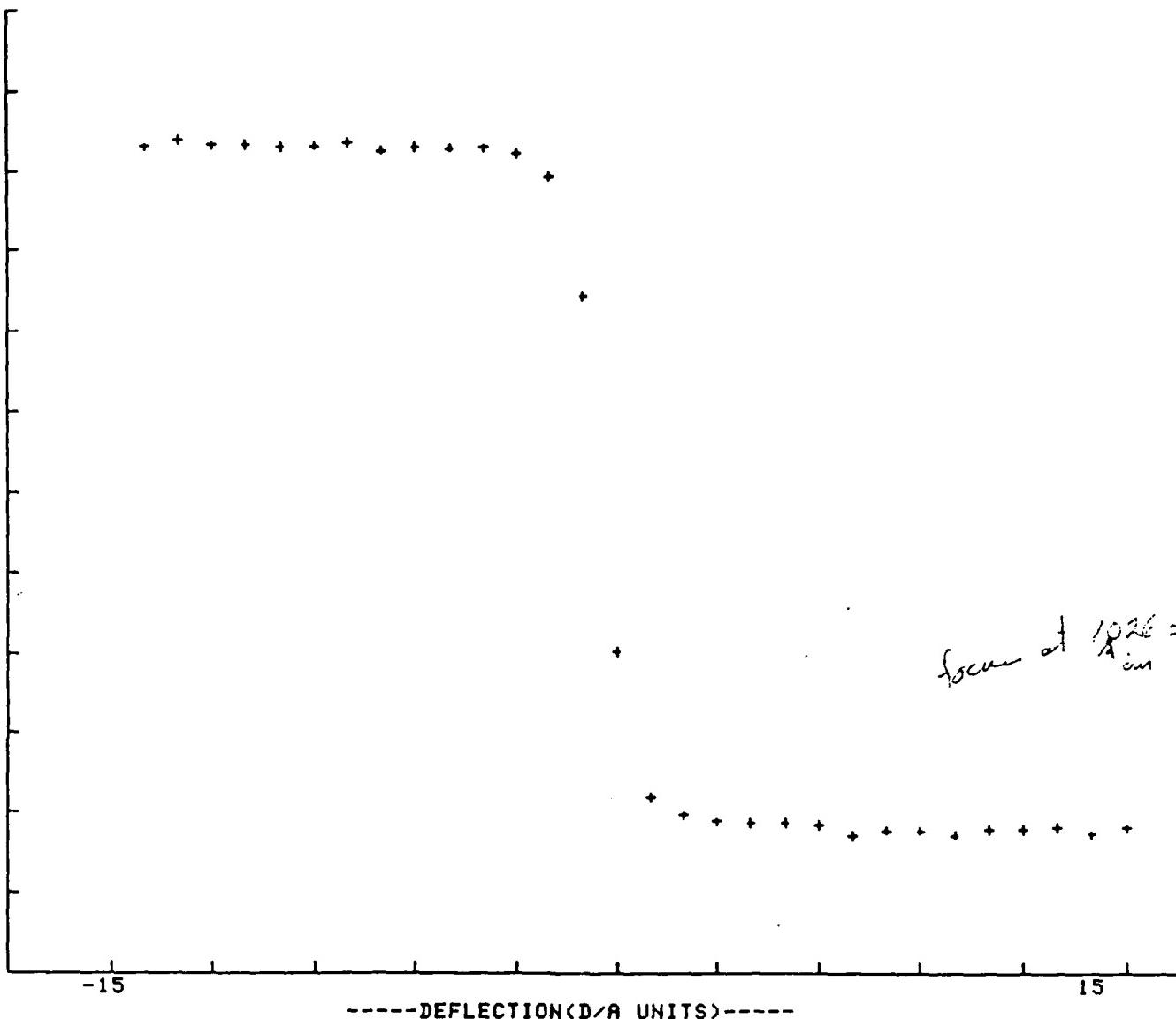


Figure 4. SAIC Drawing No. 131-18-110 001.

673-5 DUV

PREAMP No. 1 COUNTER No. 18 DIODE No. 1 THRESHOLD = 84  
SCALE MAX, SCALE MIN = 20000 0

5/17/84



Hfm1, Hfm2, FWHM, Pos. = -14.41 - .46 13.95 -7.44  
10%-90%, 90%-10%, RVE = .67 ~~.2.46~~ 1.57  
MAX COUNT, MIN COUNT = 20704.6 3523.06

STD. DEV OF EFUN = .836020563172

SUMSUM = 4220.86666667

MEAN EFUN = -4.15192341003E-02

\*\*\*QUAD08(7/24/83)\*\*\*

5/17/84  
115/130

Preamp. No. 1 2 3 4 5 6 7 8 9 10 11  
Counter No. 18 19 21 22 20 23 24 25 29 27 28 26  
Diode No. 1 2 3 4 8 8 8 8 8 0 0 0  
Threshold 84 100 80 70 254 254 254 254 254 254 254 254  
DEFLECTION FACTORS: X= 6.25 Y= 6.25 (MICRONS PER D/A)

4.3.c,d

DUV  
TUBE NO. 673-S 16KV  
DATE 5/17/84

DIGICON PERFORMANCE

c. 100 SECOND INTEGRATION DARK COUNT

Q1 = 26731

Q2 = 26313

Q3 = 25113

Q4 = 25287

TOTAL = 104944

$$C = \text{TOTAL}/400 = \underline{\underline{262}}$$

(Goal = 25)

d. QUADRANT RESPONSE UNIFORMITY

100 second count = 5100 % AVG

Q1	<u>4217</u>	<u>+2.6</u>
Q2	<u>3950</u>	<u>-3.8</u>
Q3	<u>4000</u>	<u>-2.7</u>
Q4	<u>4274</u>	<u>+4.0</u>

$$\text{AVG} = \underline{\underline{4110}}$$

(Goal =  $\pm 5\%$ )

TEST ENGINEER

L.Altas 5/17/84 QA

(SAIT  
QE4)

5/17/84

CUSTOMER (if applicable)

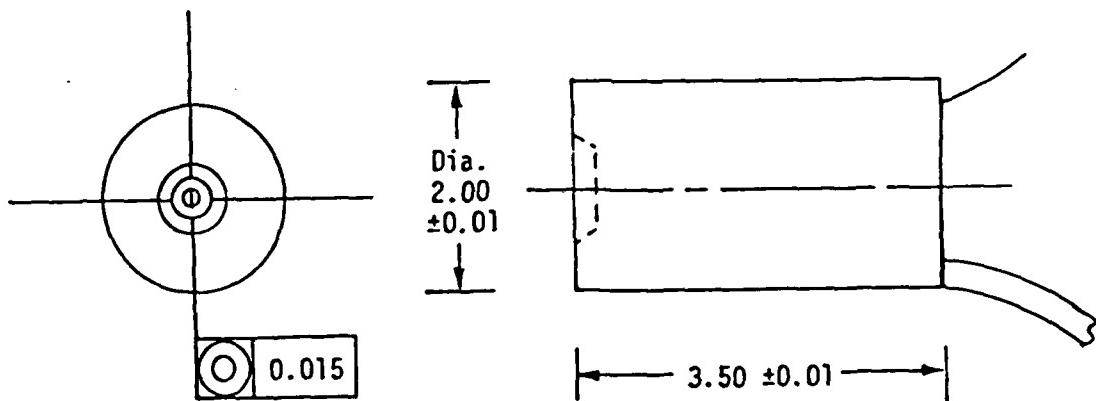
N/A

TUBE NO. 673-5 (DVU)  
DATE 5/25/84

AT 18-4.4  
Initial Release

PHYSICAL, MECHANICAL DIMENSIONS

- a. Maximum Diameter ( $2.00 \pm 0.01$  inch) 2.01 - 2.00  
b. Maximum Length ( $3.50 \pm 0.01$  inch) 3.49 - 3.51  
c. Concentricity:  
Shield, Anticorona Metalization,  
Cone I.D. Optical Inspection  
(0.015 max. TIR).....Verified OK  
d. Weight (Max. 350 g.).....Verified OK



Inspector E.Russell QA SAIT QE4  
Customer (if applicable) N/A



**SCIENCE APPLICATIONS, INC.**  
**TECHNOLOGY DEVELOPMENT GROUP (TDG)**  
TELEPHONE - SHIPPING/RECEIVING DEPT: (619) 458-3787, 458-3700

**SHIPPER CONTROL**

**NO. 1 2170**

FROM:

- ELECTRONIC VISION AND SYSTEMS DIVISION  
11526 SORRENTO VALLEY ROAD, SUITE A  
SAN DIEGO, CA 92121
- INSTRUMENTATION DEVELOPMENT LAB  
10373 ROSELLE STREET  
SAN DIEGO, CA 92121
- RAdCO™  
A DIVISION OF SCIENCE APPLICATIONS, INC.  
10373 ROSELLE STREET  
SAN DIEGO, CA 92121
- 

TO:

Mr. E.C.Aaron  
Instrumentation Technology  
Engineering, Inc  
10511 Tucker St.  
Beltsville, MD 20705

CONTRACT/PURCHASE ORDER NO.

**N00014-82-C-0363**

PROJECT NO.

**1-131-08-645**

DATE DUE

DATE SHIPPED

**6-5-84**

SHIPPING AUTHORIZATION NO'S.

**G. Russell**

SHIPMENT

PARTIAL     FINAL     COMPLETE

NET WEIGHT

GROSS WEIGHT

CUBE

NO. PACKAGES

**1**

SHIPPED VIA  
Air

CARRIER

**Emery 04948771**

FOB

PREPAID     COLLECT

REMARKS

ITEM NO	PART NO.	DESCRIPTION	UNIT OF ISSUE	QUANTITY AUTHORIZED	QUANTITY SHIPPED
1	131-18-110-000	Digicon s/n 673-5 (DVU)	ea	1	1

WHITE - PACKING SLIP  
BLUE - REQUESTOR  
GREEN - ACCOUNTING

CANARY - PURCHASING  
PINK - CONTRACTS  
GOLD - SHIPPING

AUTHORIZED SIGNATURE

DATE

X Gary Mulvaney

6-5-84

SERIAL NUMBER 676-5

FIRST FLIGHT TUBE (F-1)

4 June 1984



#106

Office of Naval Research  
Department of the Navy  
459 Summer Street  
Boston, MA 02210

Attention: Dr. Fred Quell

Subject: Certificate of Performance

Reference: Contract N00014-82-C-0363

Gentlemen:

Science Applications, Inc. (SAI) provides herewith two (2) copies of the "Certificate of Performance" for the FOS Digicon, SAI Part 131-18-110-000 and Serial Number 676-5 (F#1). This is to certify that the items were tested in accordance with the attached test reports, in accordance with the above referenced contract.

Should you require any additional technical information, please contact Mr. Gary Russell at (619) 458-3796.

Very truly yours,

SCIENCE APPLICATIONS, INC.

*Barbara Bashforth*

Barbara Bashforth  
Administrative Assistant  
Technology Development Group

/bb

Enclosures

cc: Mr. Pete Petiford - DCASMA, San Diego

bcc: J. McCoy  
G. Russell  
Chron  
File  
Deliverables

Science Applications, Inc. 10401 Roselle Street, San Diego, California 92121, (619) 458-3700

Other SAI Offices: Albuquerque, Atlanta, Chicago, Dayton, Denver, Huntsville, Los Angeles, Oak Ridge, San Diego, San Francisco, Tucson, and Washington, D.C.

May 30, 1984



SHAD QUAD DIGICON [1-131-08-645]

SAI P/N: 131-18-110-000  
S/N: 676-5 (F#1)

Contract No: N00014-82-C-0363  
Office of Naval Research

CERTIFICATE OF PERFORMANCE

This is to certify that the item noted was tested in accordance with the SAI Acceptance Test Procedures AT-18-4.1— Photocathode Response (QE), AT-18-4.2A— Diode Array Response, AT-18-4.3A— Digicon Performance, and AT-18-4.4— Physical, Mechanical Dimensions (Ref Request for Deviation/Waiver 5/29/84 #W8401). Test Data Summary Sheets are attached for each test. Physical test reports and data on file at this facility and are available for review by ONR.

A handwritten signature of "Gary L. Russell" is written over a horizontal line.

Gary L. Russell  
Quality Assurance

Distribution: SAI Test  
SAI QA  
SAI Contracts (4)  
SAI File

ENCAPSULATED DIGICON ACCEPTANCE TESTS (SHAD)

DIGICON NO. 676-5 (F-1)

	<u>TEST</u>	<u>DATE</u>
4.1	PHOTOCATHODE RESPONSE (QE)	<u>5/23/84</u>
4.2	DIODE ARRAY RESPONSE	
a.	Leakage	<u>5/29/84</u>
b.	Capacitance	<u>5/29/84</u>
c.	$\Delta E/E$	<u>5/29/84</u>
4.3	DIGICON PERFORMANCE	
a.	Magnification	<u>5/24/84</u>
b.	Error Function	<u>5/24/84</u>
c.	Dark Count	<u>5/24/84</u>
d.	Uniformity	<u>5/24/84</u>
4.4	PHYSICAL	
a.	Diameter	<u>5/29/84</u>
b.	Length	<u>5/29/84</u>
c.	Centering	<u>5/29/84</u> <small>(SAI 25)</small>
d.	Weight	<u>5/29/84</u>

Data Distribution:

- Test Build Log Book
- Test Lab
- Tube Engineer
- Quality Assurance
- Customer
- File

TUBE NO. 676-5 (SHAD F-1)  
 DATE 5/23/85

PHOTOCATHODE RESPONSE  
Visible Current Mode Quantum Efficiency Data Sheet

Wave-Length (nm)	Tube Signal (A)	Calibration Standard Signal (A)	Standard Calibration (QE%)	Comments	Calculated QE (%)	Goal QE (%)
360	.102 18	.767 19	19.3	BLUE FILTER IN	25.7	
400	.130 17	.804 18	15.4		24.9	25.0
460	.273 17	.162 17	10.5		17.7	
500	.456 17	.282 17	7.96	BLUE FILTER OUT	12.9	15.0
560	.462 17	.286 17	5.09		8.22	
600	.395 17	.260 17	3.86	YELLOW FILTER IN	5.86	
660	.255 17	.172 17	2.52		3.74	
700	.190 17	.119 17	1.72		2.75	2.5
760	.980 18	.425 18	.726		1.67	
800	.480 18	.119 18	.245		.988	0.1

Test Engineer L. Acton 5-23-84 QA  5/23/84  
 Customer (if applicable) Wines 

Calculated QE% =  $\frac{\text{Tube Signal}}{\text{Calibration Standard Signal}} \times \text{Standard Calibration QA\%}$

TUBE NO. 676-5 (SHAD F-1)  
DATE 3-24-84

4.3.a

DIGICON PERFORMANCE

a. MAGNIFICATION

DIODE 4

	1/2	CENTER	1/2
$\mu$ Divisions	<u>4</u>	<u>2</u>	<u>18</u>
Count Rate	<u>2250</u>	<u>4562</u>	<u>2324</u>
S (Total No. Divisions)	<u><math>50 \cdot 4 + 18</math></u>	<u>= 64</u>	
$W = S * (\mu/\text{Divisions})$	<u><math>64</math></u>	<u><math>* 10</math></u>	<u><math>= 640</math></u>
$M (\text{Magnification}) = D/W$	<u><math>400 \mu\text{m}</math></u>	<u><math>/ 640</math></u>	<u><math>= .63</math></u>
(D = Diode Width)			

DIODE 3

	1/2	CENTER	1/2
$\mu$ Divisions	<u>19</u>	<u>36</u>	<u>28</u>
Count Rate	<u>2340</u>	<u>4669</u>	<u>2370</u>
S (Total No. Divisions)	<u><math>50 + 19 + 28</math></u>	<u>= 59</u>	
$W = S * (\mu/\text{Divisions})$	<u><math>59</math></u>	<u><math>* 10</math></u>	<u><math>= 590</math></u>
$M (\text{Magnification}) = D/W$	<u><math>400 \mu\text{m}</math></u>	<u><math>/ 590</math></u>	<u><math>= .68</math></u>
(D = Diode Width)			

(Average Magnification)  $\left( \frac{M_1 + M_2}{2} \right) = .66$  Goal =  $0.6 < M < 1$

TEST ENGINEER E. Vigin



5/24/84

CUSTOMER (if applicable) Levi Miller

5/25/84

Figure 4.3a

18-4.3  
ge 5

3.c,d

TUBE NO. 6745 F-3

DATE 11-29-84

### DIGICON PERFORMANCE

#### 100 SECOND INTEGRATION DARK COUNT

Q1 = 244

Q2 = 236

Q3 = 263

Q4 = 256

TOTAL = 1003

C = TOTAL/400 = 2.5  
(Goal = 10)

#### d. QUADRANT RESPONSE UNIFORMITY

% AVG

Q1 5866 + 0.43%

Q2 5745 - 1.64%

Q3 5858 + 0.29%

Q4 5895 + 0.92%

AVG = 5841  
(Goal = ±5%)

TEST ENGINEER

E. Logan / D. Peters QA



CUSTOMER (if applicable) \_\_\_\_\_

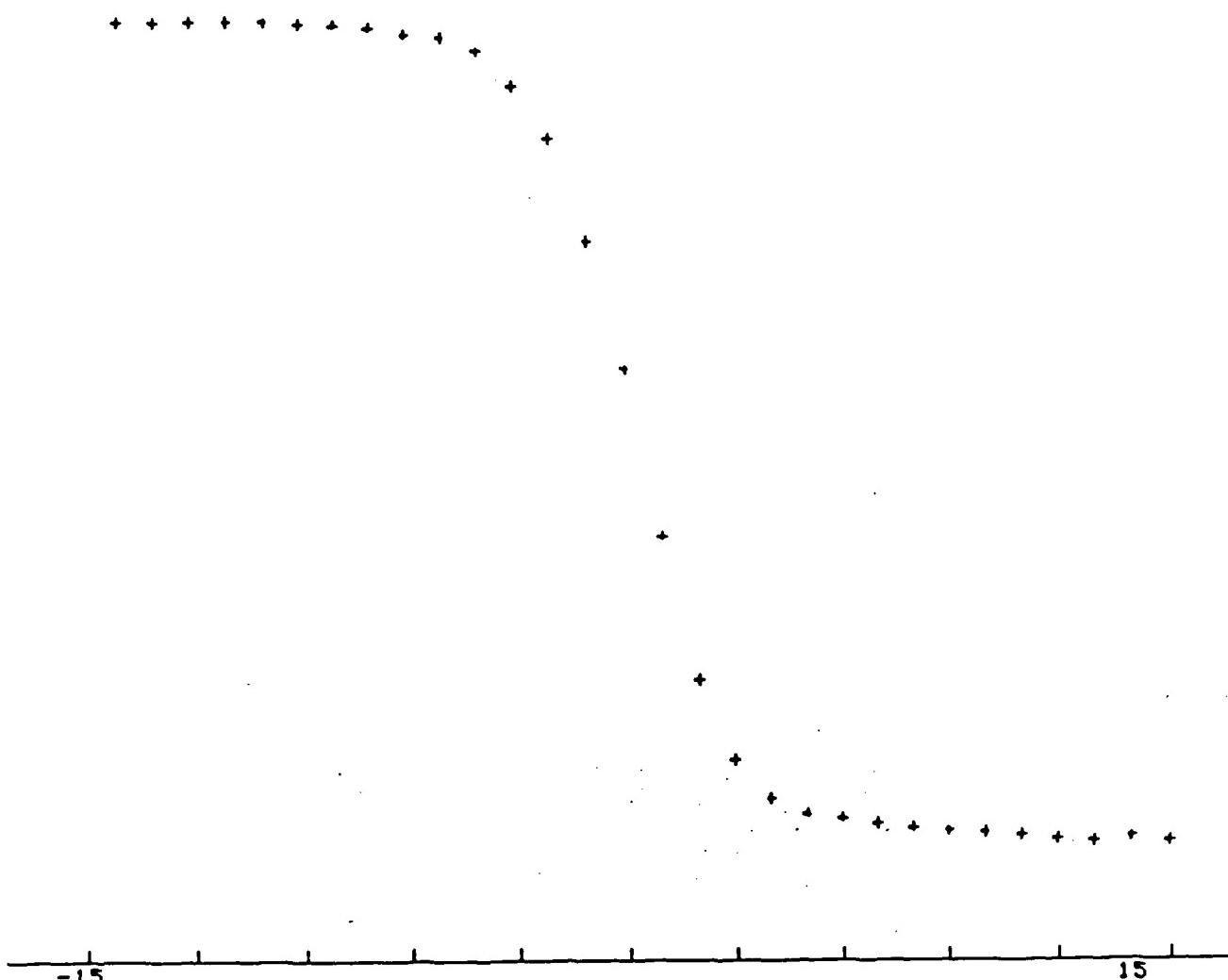
Figure 4.3b

5 / 24 /83 13 : 48 ( 55 Sec.)  
D TUBE SCAN

5 / 24 /83 13 : 55 ( 17 Sec.)  
D TUBE SCAN

US  
SWEEP @ Y = 0  
M -15 TO 15 IN 31 STEPS OF 1 EACH 1 Sec

AMP No. 1 COUNTER No. 18 DIODE No. 1 THRESHOLD = 84  
LE MAX,SCALE MIN = 20000 0



-----DEFLECTION(D/A UNITS)-----

m1,Hfm2,FWHM,Pos. = -14.44 27 14.8 -7.83  
% -90%, 90%-10%, AVE= .70 5.69 3.19  
X COUNT, MIN COUNT = 21836.5 2774.54

10 μm/CH

SAIT  
QE4

TD. DEV OF EFUN = .875349316025  
5 / 24 /83 13 : 57 ( 27 Sec.)  
\*\*\*QUARDB8(7/24/83)\*\*\*

18-4.2  
le 7

TUBE NO. 676-5 (F-1)  
DATE 5/29/84

QUAD DIGICON ARRAY RESPONSE

DIODE	PIN	LEAKAGE CURRENT (nA) Goal ≤ 1 nA	CAPACITANCE (pf) Goal ≤ 15 pf	ΔE/E Goal ≤ 0.25
Q1	2	0.9	12.2	0.25
Q2	5	1.3	11.7	0.34
Q3	9	1.1	11.4	0.33
Q4	12	1.3	12.0	0.33
G1	1	1.5	8.6	0.30
G2	3	1.1	9.1	0.35
G3	4	0.9	9.0	0.31
G4	6	1.2	9.0	0.31
G5	8	0.7	8.8	0.32
G6	10	0.5	8.6	0.38
G7	11	1.0	9.2	0.42
G8	13	0.7	9.4	0.38

SAT  
QE4 5/29/84

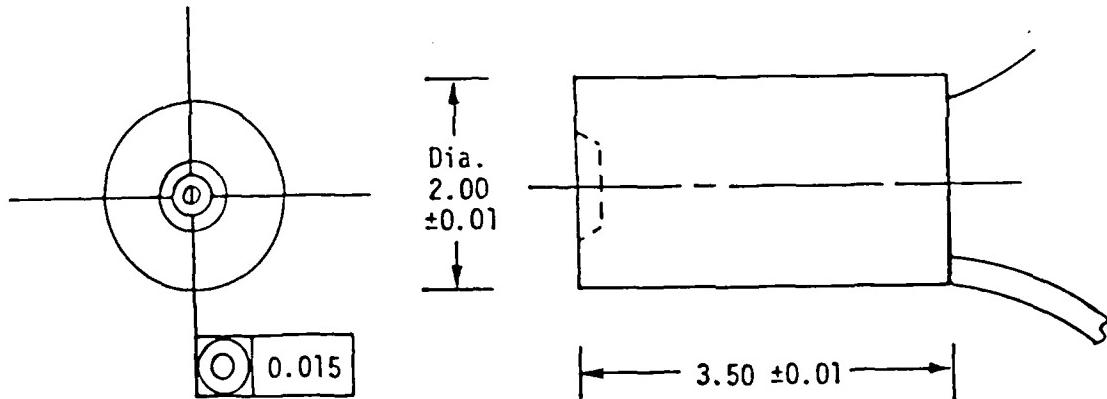
Winton P. Hutton  
J. C. S.  
5/29/84  
S. A. T.

NO. 676-5 (F-1)  
5/29/84

AT 18-4.4  
Initial Release

PHYSICAL, MECHANICAL DIMENSIONS

- a. Maximum Diameter ( $2.00 \pm 0.01$  inch) verified
- b. Maximum Length ( $3.50 \pm 0.01$  inch) verified
- c. Concentricity:  
Shield, Anticorona Metalization,  
Cone I.D. Optical Inspection  
( $0.015$  max. TIR).....Verified  $\pm 0.020$  OUT OF spec. SAI  
25
- d. Weight (Max. 350 g.).....Verified 340g approx



Inspector G.Russell QA SAIT  
OE4

Customer (if applicable) see request for Deviation/Waiver 5/29/84  
#W8401

4.3

TUBE NO. 691-5  
 DATE 10.27.84

### DIGICON PERFORMANCE

#### MAGNIFICATION

DIODE 2

	1/2	CENTER	1/2
$\mu$ Divisions	<u>637</u>	<u>—</u>	<u>584</u>
Count Rate	<u>2734</u>	<u>5800</u>	<u>2683</u>
S (Total No. Divisions)	<u>637 - 584</u>	<u>= 53</u>	
$W = S * (\mu/\text{Divisions})$	<u>53</u>	<u>* 10</u>	<u>= 530</u>
$M (\text{Magnification}) = D/W =$ (D = Diode Width)	<u>400</u>	<u>/ 530</u>	<u>= .75</u>

DIODE 4

	1/2	CENTER	1/2
$\mu$ Divisions	<u>584</u>	<u>—</u>	<u>527</u>
Count Rate	<u>2760</u>	<u>5480</u>	<u>2714</u>
S (Total No. Divisions)	<u>584 - 527</u>	<u>= 57</u>	
$W = S * (\mu/\text{Divisions})$	<u>57</u>	<u>* 10</u>	<u>= 570</u>
$M (\text{Magnification}) = D/W =$ (D = Diode Width)	<u>400</u>	<u>/ 570</u>	<u>= .70</u>

$$(\text{Average Magnification}) \left( \frac{M_1 + M_2}{2} \right) = \left( \frac{.75 + .70}{2} \right) = .725 \quad \text{Goal} = 0.6 < M < 1$$

TEST ENGINEER E. Nizam

QA

SAIT  
QE8

10/5/84

CUSTOMER (if applicable) \_\_\_\_\_

Figure 4.3a

18-4.3  
e 4

TUBE NO. 691-5  
DATE 10.4.84

.a

### DIGICON PERFORMANCE

#### a. MAGNIFICATION

DIODE 1

	1/2	CENTER	1/2
$\mu$ Divisions	<u>536</u>	<u>-</u>	<u>586</u>
Count Rate	<u>2744</u>	<u>5356</u>	<u>2747</u>
S (Total No. Divisions)	<u>586 - 536</u>	=	<u>50</u>
$W = S * (\mu/\text{Divisions})$	= <u>50</u>	* <u>10</u>	= <u>500</u>
$M (\text{Magnification}) = D/W =$	<u>400</u>	/ <u>500</u>	= <u>.80</u>
(D = Diode Width)			

DIODE 3

	1/2	CENTER	1/2
$\mu$ Divisions	<u>598</u>	<u>-</u>	<u>648</u>
Count Rate	<u>1412</u>	<u>4222</u>	<u>2088</u>
S (Total No. Divisions)	<u>648 - 598</u>	=	<u>50</u>
$W = S * (\mu/\text{Divisions})$	= <u>50</u>	* <u>10</u>	= <u>500</u>
$M (\text{Magnification}) = D/W =$	<u>400</u>	/ <u>500</u>	= <u>.80</u>
(D = Diode Width)			

$$(\text{Average Magnification}) \left( \frac{M_1 + M_2}{2} \right) = \left( \frac{1.60}{2} \right) = .80 \quad \text{Goal} = 0.6 < M < 1$$

TEST ENGINEER E. J. Zin QA SAIT DEB 10/5/84

CUSTOMER (if applicable) \_\_\_\_\_

Figure 4.3a

AT 18-4.2  
Page 7

TUBE NO. 691-5 (SiMAD 1-8)  
DATE 10-5-84

QUAD DIGICON ARRAY RESPONSE

DIODE	PIN	LEAKAGE CURRENT (nA) Goal ≤ 1 nA	CAPACITANCE (pf) Goal ≤ 15 pf	ΔE/E Goal ≤ 0.25
Q1	2	.58	78 10.0	.29
Q2	5	.63	10.5	.28
Q3	9	.86	10.7	.28
Q4	12	.54	9.7	.28
G1	1	.83	7.8	.26
G2	3	.45	8.5	.25
G3	4	.48	7.4	.25
G4	6	.59	7.7	.25
G5	8	.91	7.2	.25
G6	10	.58	8.7	.25
G7	11	.55	7.4	.25
G8	13	.46	9.5	.25

E Jozin 10-5-84

(SAIT  
QE8) 10/5/84

AT 18-4.1

TUBE NO. 691-5 (SIND F-6)  
DATE 10-4-84

## PHOTOCATHODE RESPONSE

Visible Current Mode Quantum Efficiency Data Sheet

Wave-length (nm)	Tube Signal (A)	Calibration Standard Signal (A)	Standard Calibration (QE%)	Comments	Calculated QE (%)	Goal QE (%)
	$\frac{I}{E}$	$\frac{I}{E}$				
360	.142 ±9	.166 ±9	19.3		16.5	
	1	1				
400	.232 ±8	.192 ±8	15.4		18.6	25.0
	1	1				
460	.725 ±8	.461 ±8	10.5		16.5	
	1	1				
500	1.42 ±8	.842 ±8	7.96		13.4	15.0
	1	1				
560	1.75 ±8	.933 ±8	5.09		9.55	
	1	1				
600	1.55 ±8	.785 ±8	3.86		7.62	
	1	1				
660	1.33 ±8	.631 ±8	2.52		5.31	
	1	1				
700	1.06 ±8	.445 ±8	1.72		4.10	2.5
	1	1				
760	.593 ±8	.159 ±8	.726		2.71	
	1	1				
800	3.50 ±9	.436 ±9	.245		1.97	0.1
	1	1				
	1	1				

Test Engineer E. Jozin QA SAIT QE8 10/5/84

Customer (if applicable) \_\_\_\_\_

$$\text{Calculated QE\%} = \frac{\text{Tube Signal}}{\text{Calibration Standard Signal}} \times \text{Standard Calibration QA\%}$$



SCIENCE APPLICATIONS, INC.  
APPLIED SCIENCE & TECHNOLOGY GROUP  
TELEPHONE - SHIPPING/RECEIVING DEPT.: (714) 452-9150

## SHIPPER CONTROL

NO. 10455

Systems Division  
ELECTRONIC VISION COMPANY  
1526 SORRENTO VALLEY ROAD, SUITE A  
SAN DIEGO, CA. 92121

INSTRUMENTATION DEVELOPMENT LAB  
1526 SORRENTO VALLEY ROAD, SUITE B  
SAN DIEGO, CA. 92121

EFFLUENT CONTROL LAB  
1030 SORRENTO VALLEY BLVD.  
SAN DIEGO, CA. 92121

SAI TECHNOLOGY COMPANY  
1060 SORRENTO VALLEY BLVD.  
SAN DIEGO, CA. 92121

RACT/PURCHASE ORDER NO.	PROJECT NO.	DATE DUE	DATE SHIPPED		
0014-82-C-0363	1-131-08-645-00	10/8/84	10/4/84		
SHIPPING AUTHORIZATION NO'S.	SHIPMENT	NET WEIGHT	GROSS WEIGHT	CUBE	NO. PACKAGES
	<input checked="" type="checkbox"/> PARTIAL <input type="checkbox"/> FINAL <input type="checkbox"/> COMPLETE				1
SHIPPED VIA	CARRIER	FOB	Destination	<input checked="" type="checkbox"/> PREPAID	<input type="checkbox"/> COLLECT
	Federal Express				
MARKS					

PART NO.	DESCRIPTION	UNIT OF ISSUE	QUANTITY AUTHORIZED	QUANTITY SHIPPED
	SHAD Flight Digicon #2, S/N 691-5 Line Item 0001AE Copy of Test Data	each	1	1
	ok to ship: <i>D.G. Wood</i> <i>W.H. Hoffman DCS 10/5/84</i>	each	1	1

AUTHORIZED SIGNATURE

*John Shultz*

DATE

10/4/84

ENCAPSULATED DIGICON ACCEPTANCE TESTS (SHAD)

DIGICON NO. 691-5

	<u>TEST</u>	<u>DATE</u>
4.1	PHOTOCATHODE RESPONSE (QE)	<u>10-4-84</u>
4.2	DIODE ARRAY RESPONSE	
	a. Leakage	<u>10-5-84</u>
	b. Capacitance	<u>10-5-84</u>
	c. ΔE/E	<u>10-5-84</u>
4.3	DIGICON PERFORMANCE	
	a. Magnification	<u>10-4-84</u>
	b. Error Function	<u>10-4-84</u>
	c. Dark Count	<u>10-4-84</u>
	d. Uniformity	<u>10-5-84</u>
4.4	PHYSICAL	
	a. Diameter	<u>10-5-84</u>
	b. Length	<u>10-5-84</u>
	c. Centering	<u>10-5-84</u>
	d. Weight	<u>10-5-84</u>

Data Distribution:

- Test Build Log Book
- Test Lab
- Tube Engineer
- Quality Assurance
- Customer
- File



Science Applications International Corporation

December 3, 1984

SHAD QUAD DIGICON (1-131-08-645)

SAIC P/N: 131-18-110-000  
SAIC S/N: 691-5 (F#2)

Contract No.: N00014-82-C-0363  
Office of Naval Research

CERTIFICATE OF PERFORMANCE

This is to certify that the item noted was tested in accordance with the SAIC Acceptance Test Procedures AT-18-4.1- Photocathode Response (QE), AT-18-4.2A- Diode Array Response, AT-18-4.3A- Digicon Performance, and AT-18-4.4- Physical, Mechanical Dimensions. Test Data Summary Sheets are attached for each test. Physical test reports and data are on file at this facility and are available for review by ONR.

Gary L. Russell  
Gary L. Russell  
Quality Assurance

Distribution: SAIC Test  
SAIC QA  
SAIC Contracts (4)  
SAIC File

10401 Roselle Dr., San Diego, California 92121. (619) 458-3700

Other SAIC Offices: Albuquerque, Ann Arbor, Arlington, Atlanta, Boston, Chicago, Huntsville, La Jolla, Los Angeles, McLean, Palo Alto, Santa Barbara, Sunnyvale, and Tucson



Science Applications International Corporation

#216

3 December 1984

Office of Naval Research  
Department of the Navy  
459 Summer Street  
Boston, MA 02210

Attention: Dr. Fred Quell

Subject: Certificate of Performance

Reference: Contract N00014-82-C-0363

Gentlemen:

Science Applications International Corporation (SAIC) provides herewith two (2) copies of the "Certificate of Performance" for the FOS Digicon, SAI Part Number 131-18-110-000 and Serial Number 691-5 (F#2). This is to certify that the items were tested in accordance with the attached test reports, in accordance with the above referenced contract.

Should you require any additional technical information, please contact Mr. Gary Russell at (619) 458-3796.

Very truly yours,

SCIENCE APPLICATIONS INTERNATIONAL CORP.

*Barbara Bashforth*

Barbara Bashforth  
Administrative Assistant

/bb

Enclosures

cc: Mr. Pete Petiford - DCASMA (San Diego)

SERIAL NUMBER 691-5  
SECOND FLIGHT TUBE (F-2)

MATERIAL INSPECTION AND RECEIVING REPORT		1. PROC INSTRUMENT IDENT (CONTRACT) N00014-82-C-0363			ORDER NO.	6. INVOICE NO. DATE	7. PAGE OF 1	
2. SHIPMENT NO SAI0001	3. DATE SHIPPED 84JUN07	4. B/L ICN			5. DISCOUNT TERMS 2.			
9. PRIME CONTRACTOR Science Applications, Inc. 10401 Roselle Street San Diego, CA 92121		CODE 52302			10. ADMINISTERED BY DCASMA - La Jolla Bldg. 4, AF Plant 19 4297 Pacific Highway San Diego, CA 92110			
11. SHIPPED FROM (if other than 9) CODE Same as Block 9		FOB S			12. PAYMENT WILL BE MADE BY DCASMA - Los Angeles 11099 So. La Cienega Blvd. P.O. Box 45011 Los Angeles, CA 90045			
13. SHIPPED TO Instrumentation Technology Engineering, Inc. 10511 Tucker Street Beltsville, MD 20705					14. MARKED FOR Mr. E. C. Aaron			
15. ITEM NO	16. STOCK PART NO (Indicate number of shipping containers-type of container container number)	DESCRIPTION			17. QUANTITY SHIP'D/REC'D	18. UNIT	19. UNIT PRICE	20. AMOUNT
0001 AD	The Contractor shall design, build, test and deliver one space-qualified flight model of their intensified quadrant photomultiplier tube.  SAI Part No. 131-18-100-000 Serial No. 676-5 (F-1) (18 mm Quadrant Digicon Guider Tube Assembly)				1	EA	NSP	NSP
21. PROCUREMENT QUALITY ASSURANCE					22. RECEIVER'S USE			
<input checked="" type="checkbox"/> POA <input type="checkbox"/> <small>ACCEPANCE of listed items has been made by me or under my supervision and they conform to contract except as noted herein or on supporting documents.</small>		<input type="checkbox"/> POA <input checked="" type="checkbox"/> <small>ACCEPANCE of listed items has been made by me or under my supervision and they conform to contract except as noted herein or on supporting documents.</small>			Quantities shown in column 17 were received in apparent good condition except as noted.			
84JUN07 DATE TYPED NAME AND OFFICE Pete Petiford SO514A		SIGNATURE OF AUTH GOVT REP 			DATE TYPED NAME AND TITLE 		SIGNATURE OF AUTH GOVT REP 	
23. CONTRACTOR USE ONLY								
<p><small>*If quantity received by the Government is the same as quantity shipped, indicate by ( ) mark. If different, enter actual quantity received below quantity shipped and price.</small></p>								

<b>MATERIAL INSPECTION AND RECEIVING REPORT</b>		1. PROC INSTRUMENT IDEN (CONTRACT) <b>N00014-82-C-0363</b>		2. ORDER NO.	3. INVOICE NO.	4. PAGE OF <b>1</b>	
2. SHIPMENT NO <b>SAI0001</b>	3. DATE SHIPPED <b>84JUN07</b>	4. B/L ICN	5. DISCOUNT TERMS <b>2</b>	6. ACCEPTANCE POINT <b>D</b>			
9. PRIME CONTRACTOR <b>Science Applications, Inc. 10401 Roselle Street San Diego, CA 92121</b>		CODE <b>52302</b>	10. ADMINISTERED BY <b>DCASMA - La Jolla Bldg. 4, AF Plant 19 4297 Pacific Highway San Diego, CA 92110</b>		CODE <b>S0514A</b>		
11. SHIPPED FROM (If other than 9) CODE <b>Same as Block 9</b>		52302	FOB <b>S</b>	12. PAYMENT WILL BE MADE BY <b>DCASMA - Los Angeles 11099 So. La Cienega Blvd. P.O. Box 45011 Los Angeles, CA 90045</b>		CODE <b>S0506A</b>	
13. SHIPPED TO <b>Instrumentation Technology Engineering, Inc. 10511 Tucker Street Beltsville, MD 20705</b>		14. MARKED FOR <b>Mr. E. C. Aaron</b>					
15. ITEM NO	16. STOCK PART NO (Indicate number of shipping containers-type of container container number.)	DESCRIPTION		17. QUANTITY SHIP'D,REC'D	18. UNIT	19. UNIT PRICE	20. AMOUNT
0001 AD	The Contractor shall design, build, test and deliver one space-qualified flight model of their intensified quadrant photomultiplier tube.  SAI Part No. 131-18-100-000 Serial No. 676-5 (F-1) (18 mm Quadrant Digicon Guider Tube Assembly)			1	EA	NSP	NSP
21. PROCUREMENT QUALITY ASSURANCE				22. RECEIVER'S USE			
<input checked="" type="checkbox"/> POA <input type="checkbox"/> <small>ACCEPTANCE of listed items has been made by me or under my supervision and they conform to contract except as noted herein or on supporting documents.</small>  <i>84JUN07</i> <b>Pete Petiford</b> <b>S0514A</b>		<input type="checkbox"/> POA <input checked="" type="checkbox"/> <small>ACCEPTANCE of listed items has been made by me or under my supervision and they conform to contract except as noted herein or on supporting documents.</small>  <b>Pete Petiford</b> <b>S0514A</b>		Quantities shown in column 17 were received in apparent good condition except as noted.  DATE RECEIVED      SIGNATURE OF AUTH GOVT REP <small>TYPED NAME AND OFFICE</small> <small>*If quantity received by the Government is the same as quantity shipped, indicate by ( : ) mark, if different, enter actual quantity received below quantity shipped and encircle.</small>			
23. CONTRACTOR USE ONLY							

7 June 1984

#107

Instrumentation Technology  
Engineering, Inc.  
10511 Tucker Street  
Beltsville, MD 20705

Attention: Mr. E. C. Aaron

Subject: Material Inspection & Receiving Report -  
Shipment of Photomultiplier Tube

Reference: Contract N00014-82-C-0363

Gentlemen:

In accordance with the requirements of the above referenced contract, Science Applications, Inc. (SAI) provides herewith four (4) copies of the DD Form 250, Material Inspection and Receiving Report completed to verify Shipment No. SAI0001, entitled "Quadrant Photomultiplier Tube" under Contract Line Item Number 0001AD. SAI has been directed by the ONR Technical Representative, Dr. Quell, to ship directly to your facility the enclosed tube.

If you have any questions of a technical nature, contact Mr. John McCoy at (619) 458-3794 or Mr. Gary Russell at (619) 458-3796.

Very truly yours,

SCIENCE APPLICATIONS, INC.

*Barbara Bashforth*

Barbara Bashforth  
Administrative Assistant

/bb

Enclosures

cc: Dr. Fred Quell - ONR  
Mr. Pete Petiford - DCASMA, QAR  
Mr. John Christensen - ONR (CO)

bcc: .. McCoy  
G. Russell  
Chron  
File  
Deliverables

Science Applications, Inc. 10401 Roselle Street, San Diego, California 92121, (619) 458-3700

Other SAI Offices Albuquerque, Atlanta, Chicago, Dayton, Denver, Huntsville, Los Angeles, Oak Ridge, San Diego, San Francisco, Tucson, and Washington, D.C.



DEPARTMENT OF THE NAVY  
OFFICE OF NAVAL RESEARCH  
DETACHMENT, BOSTON  
495 SUMMER STREET  
BOSTON, MA 02210

IN REPLY REFER TO

FWQ:ac1  
31 May 1984

SAI  
Attn: Gerry Russel  
Quality Assurance  
10401 Roselle Street  
San Diego, CA 92121

Dear Mr. Russel:

By authority of this letter you are advised to ship the SHAD flight  
F1 Quadrant Tube #676-5 with open waver #W8401.

Sincerely yours,

FRED W. QUELLE

REQUEST FOR DEVIATION/WAIVER  
(SEE MIL-STD-480 OH 481 FOR INSTRUCTIONS)

DATE PREPARED

5/29/84

PROCURING ACTIVITY NO.

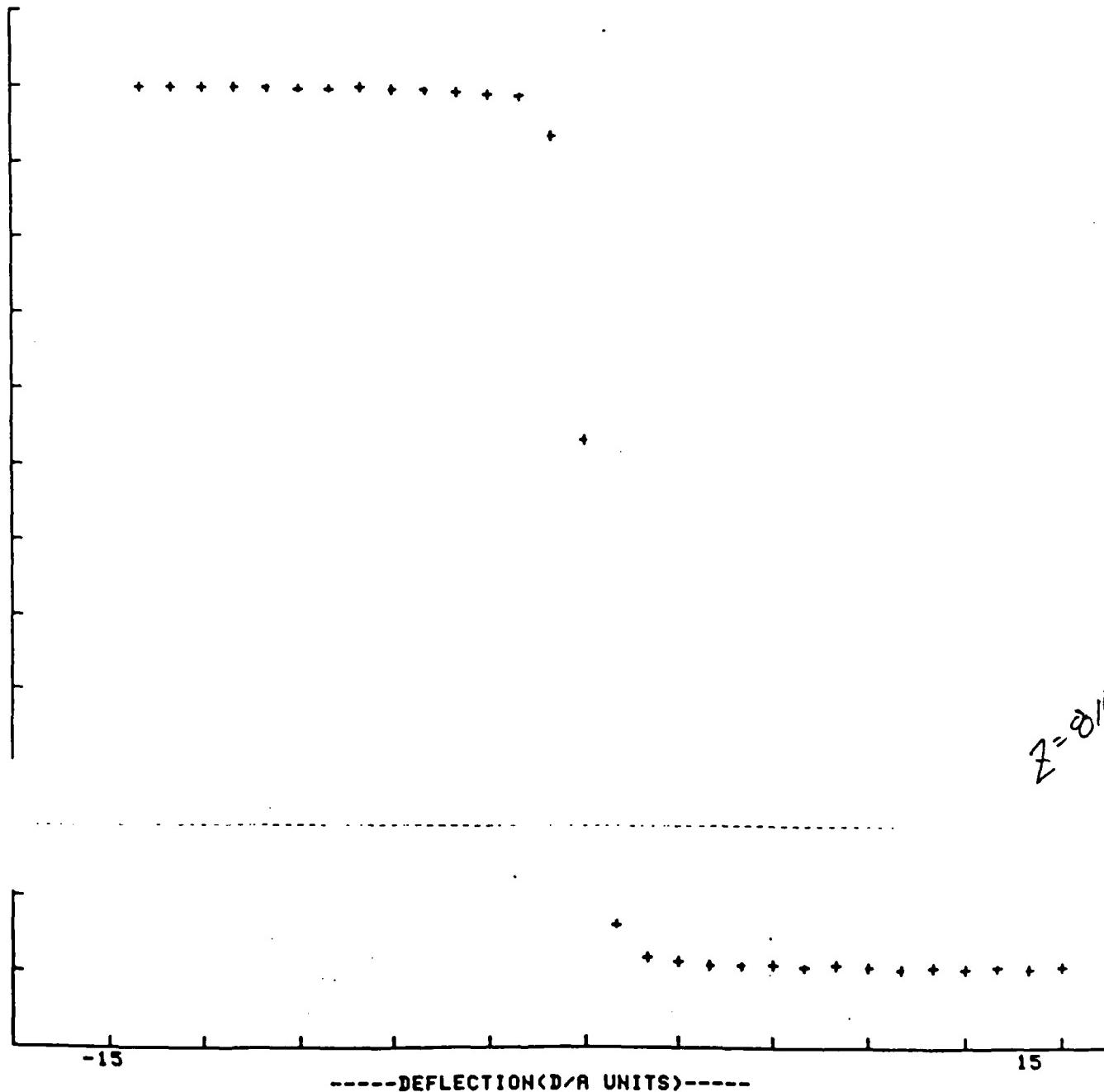
1. ORIGINATOR NAME AND ADDRESS <i>Science Applications, Inc. Electronic Vision Systems 11526 Sorrento Valley Rd., San Diego, CA 92121 Division</i>				2. <input type="checkbox"/> DEVIATION <input checked="" type="checkbox"/> WAIVER
				3. <input type="checkbox"/> MINOR <input type="checkbox"/> MAJOR <input type="checkbox"/> CRITICAL
4. DESIGNATION FOR DEVIATION/WAIVER a. MODEL/TYPE <i>18MM Digicon 60717</i> b. MFR. CODE <i>60717</i> c. SYS. DESIG. <i>WE401</i> d. DEV/WAIVER NO.				5. BASE LINE AFFECTED <input type="checkbox"/> FUNC-TIONAL <input type="checkbox"/> ALLOCATED <input checked="" type="checkbox"/> PROD-UCT
				6. OTHER SYSTEMS/CONFIGURATION ITEMS AFFECTED <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
7. SPECIFICATIONS AFFECTED-TEST PLAN				8. DRAWINGS AFFECTED MFR. CODE NUMBER REV. NOR. NO. <i>60717 131-18-10001 C</i>
9. TITLE OF DEVIATION/WAIVER <i>Mechanical Dimension - Concentricity</i>				10. CONTRACT NO. & LINE ITEM <i>N00014-82-C-0363 Item 0001</i>
11. CONFIGURATION ITEM NOMENCLATURE				12. CD NO. 13. DEFECT NO. 14. DEFECT CLASSIFICATION <input checked="" type="checkbox"/> MINOR <input type="checkbox"/> MAJOR <input type="checkbox"/> CRITICAL
15. NAME OF HIGHEST OR LOWEST ASSEMBLY AFFECTED <i>Guider Tube Assy</i>		16. PART NO. OR TYPE DESIG. <i>131-18-110-000</i>	17. LOT NO. 18. QTY <i>1 1</i>	19. RECURRING DEVIATION/WAIVER <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
20. EFFECT ON COST/PRICE <i>None</i>				21. EFFECT ON DELIVERY SCHEDULE <i>None</i>
22. EFFECT ON INTEGRATED LOGISTIC SUPPORT, INTERFACE, ETC. <i>TBD</i>				
23. DESCRIPTION OF DEVIATION/WAIVER <i>Guider tube concentricity in potted configuration - drawing specifies .015 TIR tube assembly measures ~.02 TIR, on Assembly #676-5.</i>				
(Note: Corrective Action has been instituted to preclude recurrence of this nonconformance. The potting fixture was modified and additional inspection points incorporated.)				
24. NEED FOR DEVIATION/WAIVER				
25. PRODUCTION EFFECTIVITY BY SERIAL NUMBER <i>S/N 676-5 (SHAD F#1)</i>				
26. SUBMITTING ACTIVITY AUTHORIZING SIGNATURE <i>Gary J. Russell</i>		TITLE <i>QUALITY ASSURANCE</i>		
27. APPROVAL/DISAPPROVAL a. <input type="checkbox"/> APPROVAL RECOMMENDED b. <input type="checkbox"/> APPROVED <input type="checkbox"/> DISAPPROVED c. GOVERNMENT ACTIVITY SIGNATURE DATE				

10 / 4 /83 14 : 15 ( 33 Sec.)  
QUAD TUBE SHAD F-8 RTP 10-4-84

10 / 4 /83 14 : 22 ( 31 Sec.)  
QUAD TUBE SHAD F-8 RTP 10-4-84

X-SWEEP @ Y = 0  
FROM -15 TO 15 IN 31 STEPS OF 1 EACH 1 Sec

PREAMP No. 1 COUNTER No. 18 DIODE No. 1 THRESHOLD = 60  
SCALE MAX, SCALE MIN = 20000 0



Hfm1, Hfm2, FWHM, Pos. = -14.45 .07 14.52 -7.19  
10%-90%, 90%-10%, AVE= .72 1.82 1.27  
MAX COUNT, MIN COUNT = 21932.8 2073.94

RESOLUTION  
(ERROR FUNCTION)

SAIT  
QEB

10/5/84

STD. DEV OF EFUN = .979056511223

E10/21 10-4.84

TUBE NO. 691-5 (SiAD F-8)

DATE 10-5-84

DIGICON PERFORMANCE

c. 100 SECOND INTEGRATION DARK COUNT

Q1 = 567

Q2 = 573

Q3 = 426

Q4 = 564

TOTAL = 2130

$$C = \text{TOTAL}/400 = \underline{5.325}$$

(Goal = 10)

d. QUADRANT RESPONSE UNIFORMITY

% AVG

Q1 4263 -0.95

Q2 4784 +1.03

Q3 4628 +1.02

Q4 4354 -0.97

$4507 = \frac{1}{4}$

$$\text{AVG} = \cancel{\pm 0.07} 0.99\%$$

(Goal =  $\pm 5\%$ )

TEST ENGINEER E. Kojin QA SAIT QEB 10/5/84

CUSTOMER (if applicable) \_\_\_\_\_

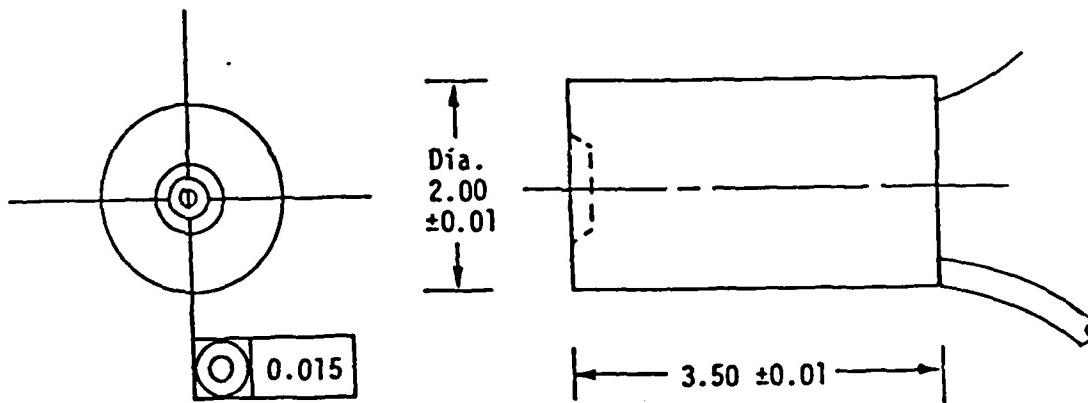
Figure 4.3b

TUBE NO. 691-5  
DATE 10-5-84

AT 18-4.4  
Initial Release

PHYSICAL, MECHANICAL DIMENSIONS

- a. Maximum Diameter ( $2.00 \pm 0.01$  inch) 2.001  
b. Maximum Length ( $3.50 \pm 0.01$  inch) 3.499  
c. Concentricity:  
Shield, Anticorona Metalization,  
Cone I.D. Optical Inspection  
(0.015 max. TIR).....Verified .012 in  
d. Weight (Max. 350 g.).....Verified .317 gram



Inspector E. Vojin 10-5-84 QA SAIT QE8 10/5/84  
Customer (if applicable) \_\_\_\_\_

SERIAL NUMBER 674-5

THIRD FLIGHT TUBE (F-3)

*Gary Russell*



Science Applications International Corporation  
#215

3 December 1984

Office of Naval Research  
Department of the Navy  
459 Summer Street  
Boston, MA 02210

Attention: Dr. Fred Quell

Subject: Certificate of Performance

Reference: Contract N00014-82-C-0363

Gentlemen:

Science Applications International Corporation (SAIC) provides herewith two (2) copies of the "Certificate of Performance" for the FOS Digicon, SAI Part Number 131-18-110-000 and Serial Number 674-5 (F#3). This is to certify that the items were tested in accordance with the attached test reports, in accordance with the above referenced contract.

Should you require any additional technical information, please contact Mr. Gary Russell at (619) 458-3796.

Very truly yours,

SCIENCE APPLICATIONS INTERNATIONAL CORP.

*Barbara Bashforth*

Barbara Bashforth  
Administrative Assistant

/bb

Enclosures

cc: Mr. Pete Petiford - DCASMA (San Diego)



Science Applications International Corporation

December 3, 1984

SHAD QUAD DIGICON (1-131-08-645)

SAIC P/N: 131-18-110-000

SAIC S/N: 674-5 (F#3)

Contract No.: N00014-82-C-0363  
Office of Naval Research

CERTIFICATE OF PERFORMANCE

This is to certify that the item noted was tested in accordance with the SAIC Acceptance Test Procedures AT-18-4.1- Photocathode Response (QE), AT-18-4.2A- Diode Array Response, AT-18-4.3A- Digicon Performance, and AT-18-4.4- Physical, Mechanical Dimensions. Test Data Summary Sheets are attached for each test. Physical test reports and data are on file at this facility and are available for review by ONR.

A handwritten signature in black ink, appearing to read "Gary L. Russell". It is written in a cursive style with a horizontal line underneath it.

Gary L. Russell  
Quality Assurance

Distribution: SAIC Test  
SAIC QA  
SAIC Contracts (4)  
SAIC File

10401 Roselle Dr. San Diego, California 92121, (619) 458-3700

Other SAIC Offices Albuquerque Ann Arbor Arlington Atlanta Boston Chicago Huntsville La Jolla Los Angeles McLean Palo Alto Santa Barbara Sunnyvale and Tucson



**SCIENCE APPLICATIONS, INC.**  
**TECHNOLOGY DEVELOPMENT GROUP (TDG)**  
 TELEPHONE - SHIPPING/RECEIVING DEPT: (619) 458-3787, 458-3700

**SHIPPER CONTROL**

**NO. 1 2174**

FROM:

- ELECTRONIC VISION AND SYSTEMS DIVISION  
11526 SORRENTO VALLEY ROAD, SUITE A  
SAN DIEGO, CA 92121
- INSTRUMENTATION DEVELOPMENT LAB  
10373 ROSELLE STREET  
SAN DIEGO, CA 92121
- RADeCO™  
A DIVISION OF SCIENCE APPLICATIONS, INC.  
10373 ROSELLE STREET  
SAN DIEGO, CA 92121
- 

TO:

Instrumentation Technology Eng. Inc  
10511 Tucker St.  
Beltsville, MD 20705  
ATTN: Mr. E.C.Aaron

CONTRACT/PURCHASE ORDER NO.

NOCC14-82-C-0863

PROJECT NO.

1-131-08-645

DATE DUE

DATE SHIPPED

6-7-84

SHIPPING AUTHORIZATION NO'S.

J. McCoy

SHIPMENT

PARTIAL     FINAL

COMPLETE

NET WEIGHT

GROSS WEIGHT

CUBE

NO. PACKAGES

1

SHIPPED VIA

Air

CARRIER

Emery 04948767

FOB

PREPAID

COLLECT

REMARKS

ITEM NO	PART NO.	DESCRIPTION	UNIT OF ISSUE	QUANTITY AUTHORIZED	QUANTITY SHIPPED
1	131-18-100-000	18mm Quadrant Digicon Guider Tube Assy. s/n 676-5(F-1)	ea	1	1

WHITE - PACKING SLIP  
BLUE - REQUESTOR  
GREEN - ACCOUNTING

CANARY - PURCHASING  
PINK - CONTRACTS  
GOLD - SHIPPING

AUTHORIZED SIGNATURE

DATE

X Gary Mulvaney

6-7-84



SCIENCE APPLICATIONS, INC.  
APPLIED SCIENCE & TECHNOLOGY GROUP  
TELEPHONE - SHIPPING/RECEIVING DEPT.: (714) 452-9150

## SHIPPER CONTROL

NO. 10469

FROM: Systems Division

ELECTRONIC VISION COMPANY  
526 SORRENTO VALLEY ROAD, SUITE A  
SAN DIEGO, CA. 92121

INSTRUMENTATION DEVELOPMENT LAB  
11526 SORRENTO VALLEY ROAD, SUITE B  
SAN DIEGO, CA. 92121

EFFLUENT CONTROL LAB  
4030 SORRENTO VALLEY BLVD.  
SAN DIEGO, CA. 92121

SAI TECHNOLOGY COMPANY  
4060 SORRENTO VALLEY BLVD.  
SAN DIEGO, CA. 92121

CONTRACT/PURCHASE ORDER NO.

N00014-82-C-0363

PROJECT NO.

1-131-08-645-00

DATE DUE

12/5/84

DATE SHIPPED

12/3/84

SHIPPING AUTHORIZATION NO'S.

SHIPMENT

 PARTIAL FINAL COMPLETE

NET WEIGHT

GROSS WEIGHT

CUBE

NO. PACKAGES

1

SHIPPED VIA

Air

CARRIER

Federal Express

FOB

Dest

 PREPAID COLLECT

REMARKS

ITEM NO.	PART NO.	DESCRIPTION	AMT OF ISSUE	QUANTITY AUTHORIZED	QUANTITY SHIPPED
1	131-18-110 000	SHAD Flight Digicon #3 SAIC P/N 131-18-110 000 S/N 674-5  Line Item 0001AF	ea	1	1
2		Copy of Test Data	ea	1	1

OK to Ship *Russell 12/3/84*  
*SAIT QE4*

*Pete Peteford 12/3/84*  
*S05144*

*C-1000 601*

AUTHORIZED SIGNATURE

*X John Shockey*

DATE

12/3/84

1

PACKING SLIP

<b>MATERIAL INSPECTION AND RECEIVING REPORT</b>		1 PROC INSTRUMENT IDEN (CONTRACT) <b>N00014-82-C-0363</b>		ORDERING NO	6 INVOICE NO	7 PAGE 1 OF 1	
2 SHIPMENT NO <b>SAI0002</b>	3 DATE SHIPPED <b>84DEC03</b>	4 B/L ICN	5 DISCOUNT TERMS			8 ACCEPTANCE POINT <b>D</b>	
9 PRIME CONTRACTOR <b>Science Applications International Corp. 10401 Roselle Street San Diego, CA 92121</b>		10 ADMINISTERED BY <b>DCASMA - La Jolla Bldg. 4, AF Plant 19 4297 Pacific Highway San Diego, CA 92110</b>		CODE   <b>S0514A</b>			
11 SHIPPED FROM (If other than 9) CODE <b>52302</b>		FOB S <b>Same as Block 9.</b>	12 PAYMENT WILL BE MADE BY <b>DCASMA - Los Angeles 11099 So. La Cienega Blvd. P.O. Box 45011 Los Angeles, CA 90045</b>		CODE   <b>S0506A</b>		
13 SHIPPED TO <b>Instrumentation Technology Engineering, Inc. 10511 Tucker Street Beltsville, MD 20705</b>		14 MARKED FOR <b>Mr. E. C. Aaron</b>		CODE			
15 ITEM NO	16 STOCK PART NO <small>(Indicate number of shipping containers type of container container number.)</small>	DESCRIPTION	17 QUANTITY SHIP'D REC'D	18 UNIT	19 UNIT PRICE	20 AMOUNT	
<b>0001</b>	<b>AF</b>	<b>The Contractor shall design, build, test and deliver one space-qualified flight model of their intensified quadrant photomultiplier tube.  SAIC Part No. 131-18-110-000 Serial No. 674-5 (F#3) (18 mm Quadrant Digicon Guider Tube Assembly)</b>	<b>1</b>	<b>EA</b>	<b>NSP</b>	<b>NSP</b>	
21 PROCUREMENT QUALITY ASSURANCE				22 RECEIVER'S USE			
<input checked="" type="checkbox"/> POA <input type="checkbox"/> <small>A ORIGIN ACCEPTANCE of listed items has been made by me or under my supervision and they conform to contract, except as noted herein or on supporting documents.</small>		<input type="checkbox"/> POA <input checked="" type="checkbox"/> <small>B DESTINATION ACCEPTANCE of listed items has been made by me or under my supervision and they conform to contract, except as noted herein or on supporting documents.</small>		<small>Quantities shown in column 17 were received in apparent good condition except as noted</small>			
 <small>DATE TYPED NAME AND OFFICE <b>Pete Petiford S0514A</b></small>		<small>DATE TYPED NAME AND TITLE</small>		<small>DATE RECEIVED SIGNATURE OF AUTH GOVT REP TYPED NAME AND OFFICE</small>			
<small>*If quantity received by the Government is the same as quantity shipped, indicate by ( ) mark. If different, enter actual quantity received below quantity shipped and encircle.</small>							
23 CONTRACTOR USE ONLY							

<b>MATERIAL INSPECTION AND RECEIVING REPORT</b>		1 PROC INSTRUMENT IDEN (CONTRACT) N00014-82-C-0363	2 ORDER NO	6 INVOICE NO	7 PAGE OF 1 1
3 MENT NO	3 DATE SHIPPED	4 B/L TCN	5 DISCOUNT TERMS		
0003	840CT04				

RE CONTRACTOR ence Applications International Corp. 01 Roselle Street Diego, CA 92121	CODE 52302	10 ADMINISTERED BY DCASMA - La Jolla Bldg. 4, AF Plant 19 4297 Pacific Highway San Diego, CA 92110	CODE S0514A
--	---------------	--	----------------

IPPED FROM (If other than 9) CODE e as Block 9.	52302	FOB S	12 PAYMENT WILL BE MADE BY DCASMA - Los Angeles 11099 So. La Cienega Blvd. P.O. Box 45011 Los Angeles, CA 90045	CODE S0506A
--	-------	-------	---	----------------

IPPED TO trumentation Technology Engineering, Inc. 11 Tucker Street tsville, MD 20705	CODE	14 MARKED FOR Mr. E. C. Aaron	CODE
--	------	----------------------------------	------

ITEM NO	16 STOCK PART NO <small>(Indicate number of shipping containers type of container container number)</small>	DESCRIPTION	17 QUANTITY SHIP'D REC'D	18 UNIT	19 UNIT PRICE	20 AMOUNT
1 AE	The Contractor shall design, build, test and deliver one space-qualified flight model of their intensified quadrant photomultiplier tube.  SAIC Part No. 131-18-110-000 Serial No. 691-5 (F#2)		1	EA	NSP	NSP

<b>PROCUREMENT QUALITY ASSURANCE</b>		22 RECEIVER'S USE <small>Quantities shown in column 17 were received in apparent good condition except as noted</small>
A ORIGIN <input checked="" type="checkbox"/> I ACEPTANCE of listed items is made by me or under my supervision and they conform to contract except as noted herein or on supporting documents.	B DESTINATION <input type="checkbox"/> POA <input checked="" type="checkbox"/> I ACEPTANCE of listed items has been made by me or under my supervision and they conform to contract except as noted herein or on supporting documents.	DATE RECEIVED      SIGNATURE OF AUTH GOVT REP <small>TYPED NAME AND OFFICE</small>
DATE <u>2006</u> SIGNATURE OF AUTH GOVT REP  NAME OFFICE Pete Petiford S0514A	DATE TYPED NAME AND TITLE	SIGNATURE OF AUTH GOVT REP <small>*If quantity received by the Government is the same as quantity shipped, indicate by a checkmark. If different enter actual quantity received below quantity shipped and encircle.</small>

CONTRACTOR USE ONLY

ENCAPSULATED DIGICON ACCEPTANCE TESTS (SHAD)

DIGICON NO. 674-5  
F-3

	<u>TEST</u>	<u>DATE</u>
4.1	PHOTOCATHODE RESPONSE (QE)	<u>12-3-84</u>
4.2	DIODE ARRAY RESPONSE	
a.	Leakage	<u>11-30-84</u>
b.	Capacitance	<u>11-30-84</u>
c.	ΔE/E	<u>11-30-84</u>
4.3	DIGICON PERFORMANCE	
a.	Magnification	<u>11-29-84</u>
b.	Error Function	<u>11-29-84</u>
c.	Dark Count	<u>11-29-84</u>
d.	Uniformity	<u>11-29-84</u>
4.4	PHYSICAL	
a.	Diameter	<u>11-30-84</u>
b.	Length	<u>11-30-84</u>
c.	Centering	<u>11-30-84</u>
d.	Weight	<u>11-30-84</u>

Data Distribution:

- Test Build Log Book
- Test Lab
- Tube Engineer
- Quality Assurance
- Customer
- File

SAIT  
QA/QC

12/3/84

TUBE NO. 674-5 F-3  
 DATE 12-3-84  
 (ATP)

PHOTOCATHODE RESPONSE

Visible Current Mode Quantum Efficiency Data Sheet

Wave-length (nm)	Tube Signal (A)	Calibration Standard Signal (A)	Standard Calibration (QE%)	Comments	Calculated QE (%)	Goal QE (%)
	$\frac{I_E}{I}$	$\frac{I_E}{I}$				
360	2.24 ± 9	1.98 ± 9	19.3		24.3	
	1	1				
400	2.05 ± 9	1.43 ± 9	15.4		22.1	25.0
	1	1				
460	1.994 ± 8	2.48 ± 9	10.5		17.6	
	1	1				
500	1.96 ± 8	1.11 ± 8	7.96		14.1	15.0
	1	1				
560	2.14 ± 8	1.16 ± 8	5.09		9.39	
	1	1				
600	1.79 ± 8	0.958 ± 8	3.86		7.21	
	1	1				
660	1.38 ± 8	0.724 ± 8	2.52		4.80	
	1	1				
700	1.03 ± 8	0.496 ± 8	1.72		3.57	2.5
	1	1				
760	0.496 ± 8	0.168 ± 8	0.726		2.14	
	1	1				
800	0.940 ± 9	0.186 ± 9	0.245		1.24	0.1
	1	1				
	1	1				

Test Engineer E. J. Ogiu

QA



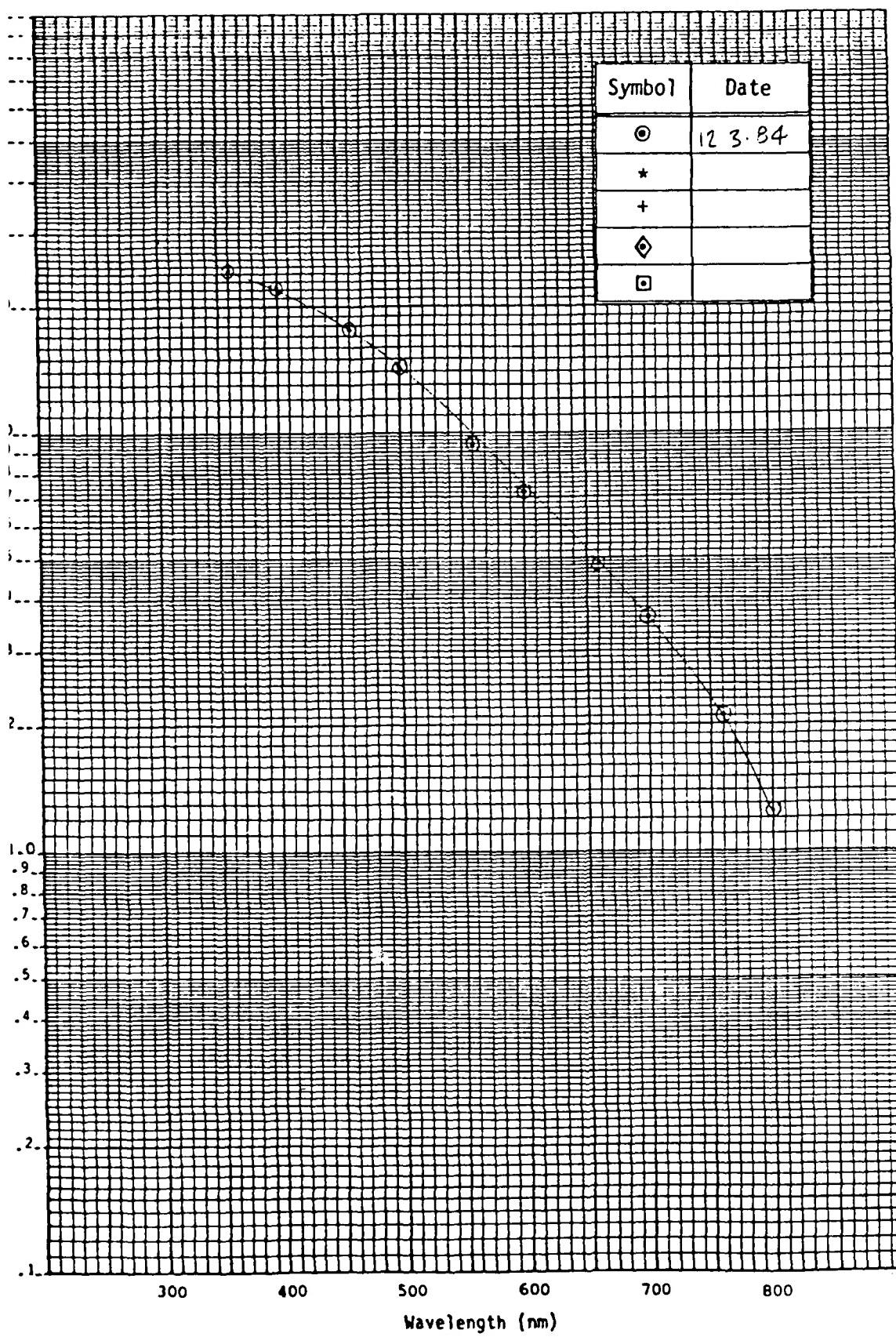
Customer (if applicable) \_\_\_\_\_

$$\text{Calculated QE\%} = \frac{\text{Tube Signal}}{\text{Calibration Standard Signal}} \times \text{Standard Calibration QE\%}$$

AT-3018

TUBE NO. 574-5

F-3



TUBE NO. 674-5 F-3

DATE 11.30.84

QUAD DIGICON ARRAY RESPONSE

DIODE	PIN	LEAKAGE CURRENT (nA) Goal ≤ 1 nA	CAPACITANCE (pf) Goal ≤ 15 pf	ΔE/E Goal ≤ 0.25
Q1	2	2.4	10.6	0.26
Q2	5	2.08	10.4	0.28
Q3	9	3.0	10.3	0.30
Q4	12	3.18	10.6	0.27
G1	1	.47	7.4	0.23
G2	3	.93	7.8	0.21
G3	4	.45	7.6	0.27
G4	6	.65	7.6	0.20
G5	8	.80	7.5	0.21
G6	10	.62	7.8	0.20
G7	11	.46	7.5	0.26
G8	13	.52	7.8	0.21

(SAIT  
QE4)

ATURE = 0 DEGREES CENTIGRADE

672-5

TUBE SCAN

2 / 2 /83 9 : 55 ( 10 Sec.)  
ROUND COUNT FOR 10 INTERVALS OF 1 SEC EACH

LECTION OF X= 0 & Y= 0

INC. ACCEPTED = 5

LIMIT = 100 COUNTS

ATURE = 0 DEGREES CENTIGRADE

DIODE NUMBER	-----COUTNS-----		
	ISOLATED	FILTERED	TOTAL
1	0	118	118
2	0	96	96
3	0	95	95
4	0	93	93
ILS	-----	402	402

INTERVALS REJECTED; 0 INTERVALS WITHOUT COUNTS

ATURE = 0 DEGREES CENTIGRADE

TUBE SCAN

2 / 2 /83 9 : 57 ( 0 Sec.)  
ROUND COUNT FOR 100 INTERVALS OF 1 SEC EACH

LECTION OF X= 0 & Y= 0

INC. ACCEPTED = 5

LIMIT = 100 COUNTS

ATURE = 0 DEGREES CENTIGRADE

R DIODE NUMBER	-----COUTNS-----		
	ISOLATED	FILTERED	TOTAL
1	0	1118	1118
2	0	975	975
3	0	874	874
4	0	946	946
RLS	-----	3913	3913

INTERVALS REJECTED; 0 INTERVALS WITHOUT COUNTS

ATURE = 0 DEGREES CENTIGRADE

TUBE NO. 672-5  
DATE 2/2/84

SHAD DIGICON DARK COUNT

10 SECOND INTEGRATION

Q1 = 1118  
Q2 = 975  
Q3 = 874  
Q4 = 946  
TOTAL = 3913

C = TOTAL/400 = 9.78

QUADRANT UNIFORMITY

	% AVG
Q1 <u>3750</u>	<u>99.87</u>
Q2 <u>3760</u>	<u>100.13</u>
Q3 <u>3750</u>	<u>99.87</u>
Q4 <u>3760</u>	<u>100.13</u>

AVG = 3755

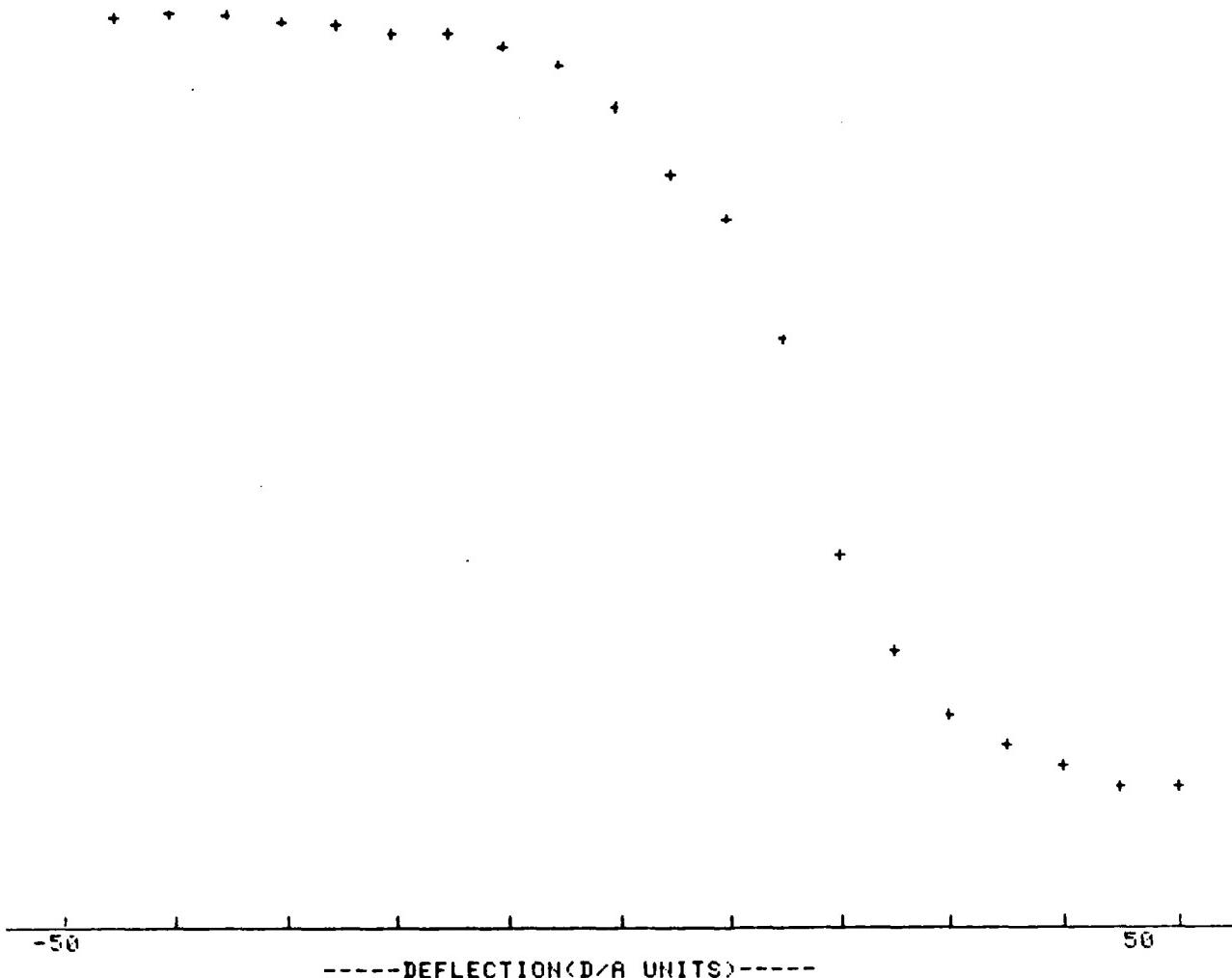
EST ENGINEER \_\_\_\_\_ QA \_\_\_\_\_

2 / 2 /83      16 : 12      ( 21 Sec.)

SP/SEP

672 RESOLUTON  
IEEP @ Y = 0  
-50 TO 50 IN 21 STEPS OF 5 EACH 1 Sec

1P No. 1 COUNTER No. 18 DIODE No. 1 THRESHOLD = 54  
E MAX,SCALE MIN = 20000 0

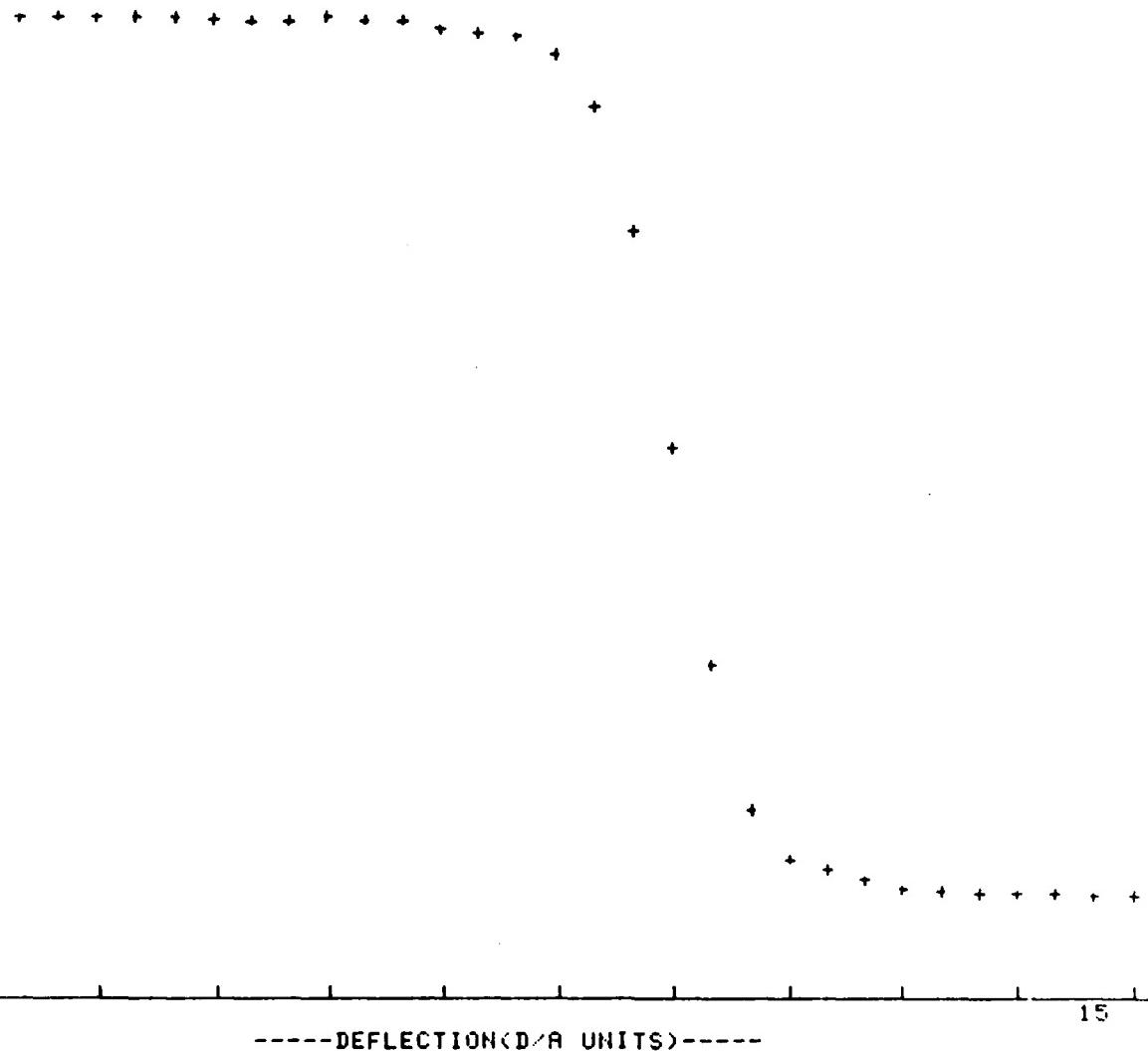


-----DEFLECTION(D/A UNITS)-----

I, Hfm2, FWHM, Pos. = -47.09 16.35 63.44 -15.37  
-90%-90%-10%, AVE= 3.36 31.05 17.2 = 21.05  $\mu$   
COUNT, MIN COUNT = 20884.4 3374.68

2 / 2 /83      9 : 34      ( 3 Sec.)  
ID TUBE SCAN

(OR FUNCTION (FINE) 2/2/84  
SWEEP @ Y = -2  
)M -15 TO 15 IN 31 STEPS OF 1 EACH 1 Sec  
RAMP No. 1 COUNTER No. 18 DIODE No. 1 THRESHOLD = 84  
RLE MAX,SCALE MIN = 20000 0



-----DEFLECTION(D/A UNITS)-----

M1, HFM2, FWHM, Pos. = -14.45 3.04 17.49 -5.7  
1%-90%, 90%-10%, AVE= .72 4.04 2.38 RES = 40.4 $\mu$   
MAX COUNT, MIN COUNT = 21779.7 2278.21      1 D/A = 10 $\mu$

STD. DEV OF EFUN = .906151062727  
SUMSUM = 2718.4  
MEAN EFUN = .224906928429

TUBE NO. 672-5  
DATE 2/3/84

SHAD DIGICON MAGNIFICATION TEST

DIODE 2

	1/2	CENTER	1/2
$\mu$ Divisions	<u>5.4</u>		<u>2.2</u>
Count Rate	<u>2925</u>	<u>6000</u>	<u>3065</u>
S (Total No. Divisions)	<u>25 - 5.4 + 2.2</u>	=	<u>21.8</u>
$W = S * (\mu/\text{Divisions})$	= <u>21.8</u>	* <u>25.4</u>	= <u>553.72</u>
M (Magnification) = D/W	= <u>400</u>	/ <u>553.72</u>	= <u>0.722</u>
(D = Diode Width)			

DIODE \_\_\_\_\_

	1/2	CENTER	1/2
$\mu$ Divisions	_____	_____	_____
Count Rate	_____	_____	_____
S (Total No. Divisions)	_____	=	_____
$W = S * (\mu/\text{Divisions})$	= _____	* _____	= _____
M (Magnification) = D/W	= _____	/ _____	= _____
(D = Diode Width)			

TEST ENGINEER Action/McCoy QA \_\_\_\_\_

Figure 5

VISIBLE CURRENT MODE QUANTUM EFFICIENCY DATA SHEET

Wave-length (nm)	Standard Calibration (mA/w)/Q.E.	Standard Signal Current (nA)	Calculated Monochro- mator Out- Put ( $\mu$ W)	Tube Signal Current ( $\mu$ A)	Calculated Q.E. (%)	Spec Q.E. (%)
400 nm	15.4	.644E-9		1.09 E-9	24.87	25.0
420 nm		(.616E-9)		(1.02 E-9)	(25.5)	
440 nm						
460 nm	10.5	1.46E-9		2.59E-9	18.27	
480 nm						
500 nm	7.96	2.82E-9		.508E-8	14.34	15.0
520 nm						
540 nm						
560 nm	5.09	.306E-8		.578E-8	9.6	
580 nm						
600 nm	3.86	.252E-8		.467E-8	7.15	
620 nm						
640 nm						
660 nm	2.52	.200E-8		.396E-8	4.36	
680 nm						
700 nm	1.72	.142E-8		.238E-8	2.68	2.5
720 nm						
740 nm						
760 nm	.726	.498E-9		.836E-9	1.22	
780 nm						
800 nm	,295	.132E-9		.222E-9	0.3	0.1
820 nm						
840 nm						
860 nm	.017					
880 nm						
900 nm	,002					<0.1

Date 10/11/1984 Tube S/N: 672-5 Test Eng. Acton

Q.A. \_\_\_\_\_ Q.A. Verification of Equipment Calibration \_\_\_\_\_

PHOTOCATHODE RESPONSE  
Visible Current Mode Quantum Efficiency  
Data Sheet

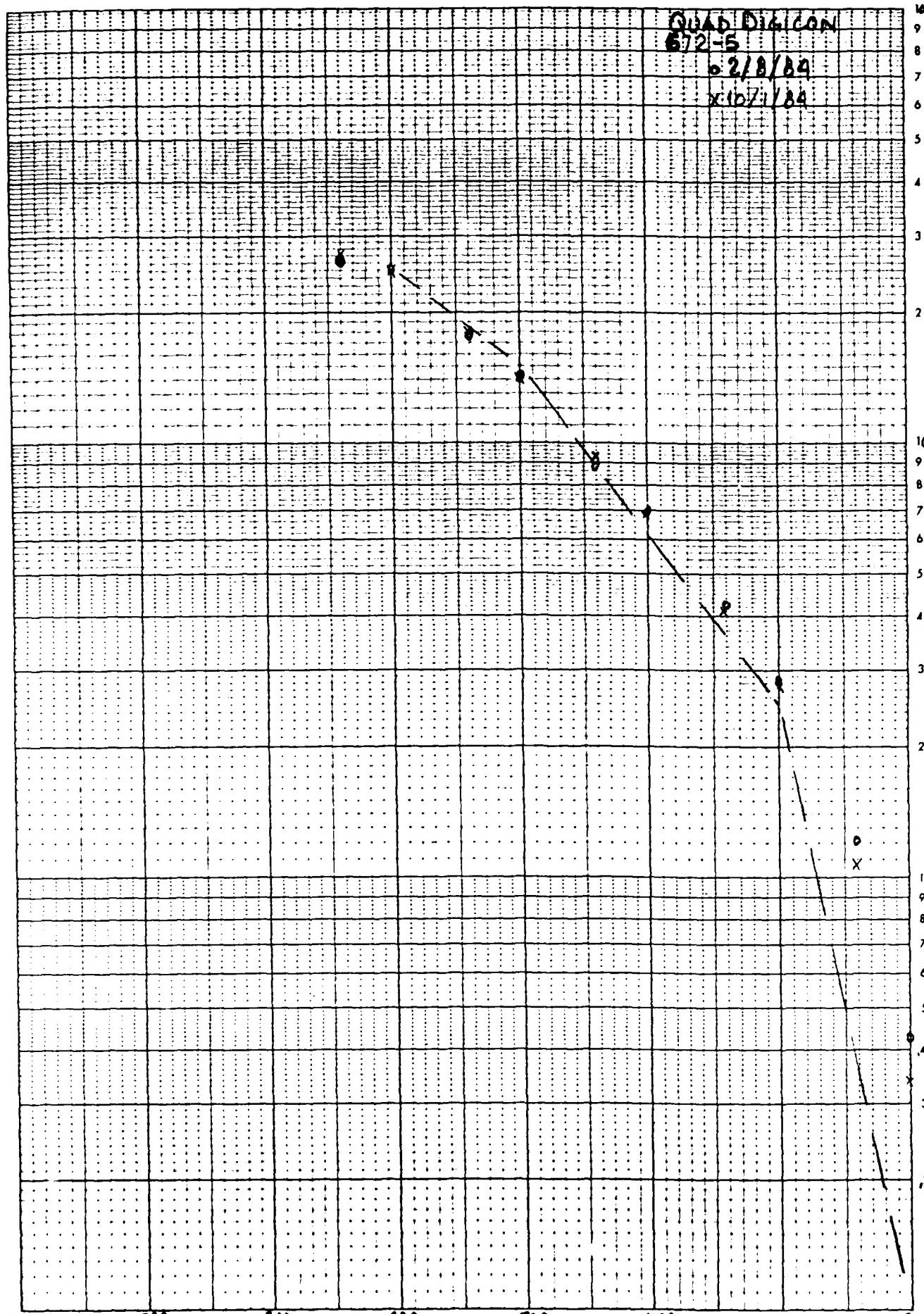
Tube No. 672-5  
Date 2-8-84

Wavelength (nm)	UUT Tube Signal (A)	Calibration Standard Signal (A)	Standard Calibration (QE%)	Comments	UUT Calculated QE (%)	Goal QE (%)
360	.487 -10	.36 -10	19.3	Blue Filter	26.1	
400	.605 -9	.377 -9	15.4	"	24.7	25.0
460	.150 -8	.890 -9	10.5	"	17.7	
500	.305 -8	.173 -8	7.96	no filter	14.0	15.0
560	.352 -8	.201 -8	5.09	"	8.91	
600	.286 -8	.159 -8	3.86	Orange Filter	6.94	
660	.213 -8	.126 -8	2.52	"	4.26	
700	.148 -8	.0885 -9	1.72	"	2.88	2.5
760	.514 -9	.308 -9	.726	"	1.21	
800	.148 -9	.085 -10	.245	"	0.43	0.1
<del>850</del>						

Test Engineer J. Actor QA \_\_\_\_\_  
Customer (if applicable) \_\_\_\_\_

$$\text{Calculated QE\%} = \frac{\text{Tube Signal}}{\text{Cal. Std. Signal}} \times \text{Std. Cal. QE\%}$$

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log



UNENCAPSULATED DIGICON TESTS (SHAD)

DIGICON NO. 672-5

<u>TEST</u>	<u>DATE</u>	
PHOTOCATHODE RESPONSE	<u>1/11/84</u>	<u>2/8/84</u>
DIODE ARRAY RESPONSE		
Leakage (12)	<u>2/10/84</u>	
Capacitance (12)	<u>2/10/84</u>	
ΔE/E (12)	<u>2/10/84</u>	
DIGICON PERFORMANCE		
Magnification	<u>2/3/84</u>	.72
Error Function	<u>2/2/84</u>	40.1
Dark Count	<u>2/2/84</u>	9.78
Uniformity	<u>2/2/84</u>	±.1%

SERIAL NUMBER 672-5

UNENCAPSULATED TUBE (SPARE)

TUBE NO. 674-5 F-3  
DATE 11-30-84

AT 18-4.4  
Initial Release

PHYSICAL, MECHANICAL DIMENSIONS

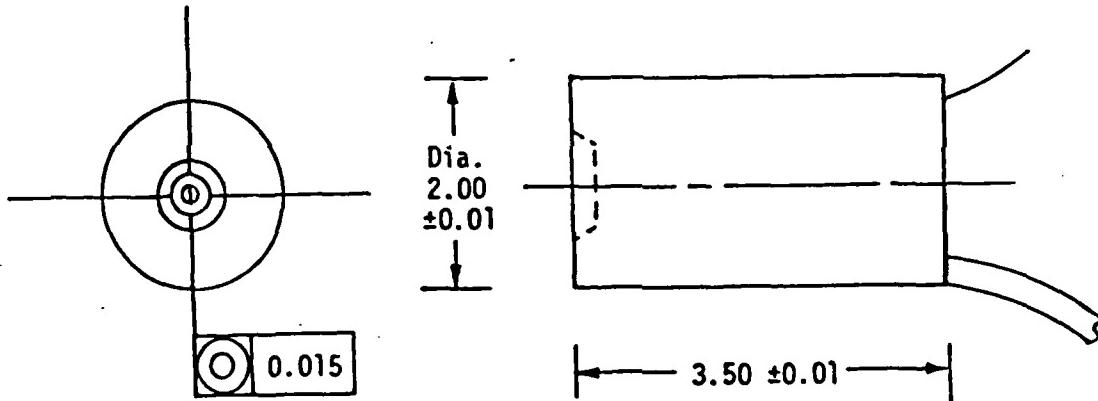
a. Maximum Diameter ( $2.00 \pm 0.01$  inch) 2.004

b. Maximum Length ( $3.50 \pm 0.01$  inch) 3.503

c. Concentricity:

Shield, Anticorona Metalization,  
Cone I.D. Optical Inspection  
(0.015 max. TIR).....Verified E. Vojin

d. Weight (Max. 350 g.).....Verified E. Vojin (290g)



Inspector E. Vojin

QA

SAIT  
QE4

Customer (if applicable) Dan Reising John Taylor

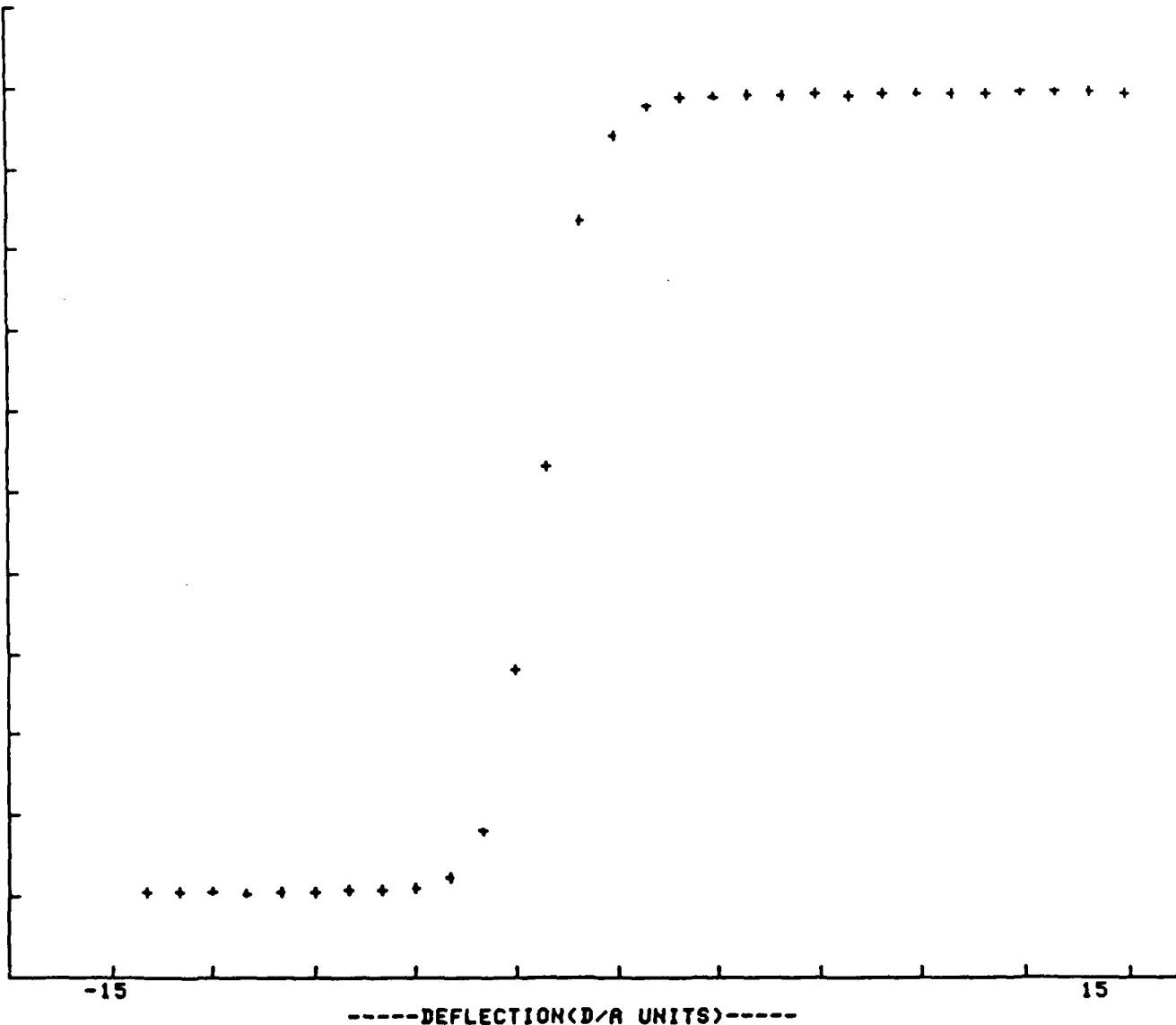
*84*  
11 / 29 / 83 12 : 29 ( 38 Sec.)  
QUAD TUBE SCAN SHAD F-3 11.29.84

*84*  
11 / 29 / 83 13 : 49 ( 44 Sec.)  
QUAD TUBE SCAN SHAD F-3 11.29.84

X-SWEEP @ Y = -13  
FROM -15 TO 15 IN 31 STEPS OF 1 EACH 1 Sec

PREAMP No. 1 COUNTER No. 18 DIODE No. 1 THRESHOLD = 54  
SCALE MAX, SCALE MIN = 20000 0

Error Function  
Digicon # 674-5  
F-3



Hfm1, Hfm2, FWHM, Pos. = -2.19 15 17.19 6.4  
10%-90%, 90%-10%, AVE= 3.69 0 1.84  
MAX COUNT, MIN COUNT = 21927.7 1416.72

36.9 *mm*

SAIT  
QE4

STD. DEV OF EFUN = .935928721891  
SUMSUM = 3793.46666667  
MEAN EFUN = .176272619362

*J. Petos*

TUBE NO. 674-5 F-3  
DATE 11.29.84

SHAD DIGICON MAGNIFICATION TEST

DIODE Q3

	1/2	CENTER	1/2
$\mu$ Divisions	<u>532</u>	<u>498</u>	<u>464</u>
Count Rate	<u>2953</u>	<u>5720</u>	<u>3320</u>
S (Total No. Divisions)	<u><math>\frac{532+464}{50}</math></u>	= <u>48</u>	
$W = S * (\mu/\text{Divisions})$	= <u>48</u>	$* \frac{10\mu}{}$	<u>480</u>
M (Magnification) = D/W	= <u><math>\frac{400\mu}{480}</math></u>	<u>1.680</u>	<u>.588</u>
(D = Diode Width)			

DIODE Q4

	1/2	CENTER	1/2
$\mu$ Divisions	<u>462</u>	<u>492</u>	<u>523</u>
Count Rate		<u>5843</u>	
S (Total No. Divisions)	<u><math>523 - 462</math></u>	= <u>61</u>	
$W = S * (\mu/\text{Divisions})$	= <u>61</u>	$* \frac{10\mu}{}$	<u>610</u>
M (Magnification) = D/W	= <u><math>\frac{400\mu}{610}</math></u>	<u>1.654</u>	
(D = Diode Width)			

TEST ENGINEER E. Joyin / D. Gitter QA SAIT QE4

TUBE NO. 674-5 F-3  
DATE 11.29.84

SHAD DIGICON MAGNIFICATION TEST

DIODE Q1

	1/2	CENTER	1/2
$\mu$ Divisions	<u>528</u>	<u>494</u>	<u>465</u>
Count Rate	<u>2862</u>	<u>5782</u>	<u>3078</u>
S (Total No. Divisions)	<u>528-465</u>	= <u>63</u>	
$W = S * (\mu/\text{Divisions})$	= <u>63</u>	* <u>10<math>\mu</math></u>	= <u>630</u>
M (Magnification) = D/W	= <u>400<math>\mu</math></u>	/ <u>630</u>	= <u>.635</u>
(D = Diode Width)			

DIODE Q2

	1/2	CENTER	1/2
$\mu$ Divisions	<u>465</u>	<u>434</u>	<u>403</u>
Count Rate	<u>3124</u>	<u>5802</u>	<u>2984</u>
S (Total No. Divisions)	<u>465-403</u> = <u>62</u>		
$W = S * (\mu/\text{Divisions})$	= <u>62</u>	* <u>10<math>\mu</math></u>	= <u>620</u>
M (Magnification) = D/W	= <u>400<math>\mu</math></u>	/ <u>620</u>	= <u>.645</u>
(D = Diode Width)			

TEST ENGINEER

E. Dugay

QA

SAIT  
0E4

**END**

**FILMED**

**5-85**

**DTIC**